

# OF THE STATE OF HAWAII

In the Matter of the Application	)
MOLOKAI PUBLIC UTILITIES, INC.	) DOCKET NO. 2009-0048
For review and approval of rate increases; revised rate schedules; and revised rules.	) )

#### WEST MOLOKAI ASSOCIATION'S RESPONSES TO MOLOKAI PUBLIC UTILITIES, INC.'S INITIAL 26 INFORMATION REQUESTS (INCLUDING 93 SUB-PARTS)

and

**CERTIFICATE OF SERVICE** 

PUBLIC UTILITIES

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#### MPU-IR-WMA-101 Ref: WMA Testimony-1. p.1.1.17-18

- a. Identify each of the 812 separate, owned interests in real property that are active members of WMA.
  - 1. How many members pay annual dues?
  - When was the last membership meeting held and how many members attended?
  - 3. How many members reviewed WMA's presentation (including information requests, testimony, etc.) in MPU's rate proceeding?
  - 4. Did the WMA Board meet to discuss and approve the presentation?

RESPONSE: All WMA members can participate in WMA affairs in person or by proxy at annual meetings, by sitting on committees, by communication and interaction with the WMA Board of Directors either personally or through their condominium or homeowner association representatives. In this regard, all members are active regardless of how they participate or whether they choose to participate.

WMA, like most membership organizations, principally operates through a Board of Directors.

- Annual dues are paid by 811 real property interests/units. This
  number is not precisely the same as the "membership," because
  some members either own more than one unit, or have more than
  one voting unit assigned to it (i.e. the hotel).
- The last membership meeting was held on March 21, 2009. There was a quorum present in person or by proxy.

- 3. The property, business and affairs of WMA are managed by a Board of Directors; the Board of Directors appointed a Working Group on water matters to assist with rate proceedings such as HPUC Docket 2009-0048. Currently the Working Group is comprised of 6 persons. The Working Group reports to the members of the Board of Directors. The most recent Board of Director meeting was held on January 23, 2010.
- Yes. The full Board met on December 17, 2009, to discuss the MPUI rate case. This was the last Board meeting prior to the filing of WMA's direct testimonies on January 6, 2010.

**SPONSOR:** Lyle Dunham

MPU-IR-WMA-102 Ref: WMA Testimonv-1. p.1.1.20-21

Identify each of the differences between "what we have" and "what

we once had."

RESPONSE: "What we have" is rapidly deteriorating roads, with no definable shoulders

and innumerable large potholes; intersections that are no longer controlled

with legible traffic control signs or lights. There is an abandoned and

deteriorating restaurant and hotel adjacent to condominium units, the golf

course is closed and unwatered and fire hydrants are being neglected.

This list of items could contain many more items.

"What we once had," was a working relationship with the owner/developer of the Kaluakoi Complex, who made a golf course available, maintained a modest resort which had the only amenities available without lengthy, time-consuming drives to Kaunakakai. Most importantly, members of WMA held reasonable expectations that the resort would be developed, in an orderly fashion, so that there would be expansion of improvements on individually owned parcels. More pertinent to this proceeding, WMA members had a water system that provided potable water at reasonable rates, with some leakage. What we now have is a water system that leaks approximately 300% more than the generally accepted standard; and rates which may be the Nation's highest rates (i.e. an effective rate of a penny a gallon).

SPONSOR:

Lyle Dunham

MPU-IR-WMA-103 Ref: WMA Testimony-1, p.2.1.12-13

Identify each action that has result in "manipulation" or

"abandonment".

RESPONSE: "Abandonment" is a term that is particularly appropriate to MPL, under the

current set of circumstances, where it appears to WMA, that the MPL has

no near-term interest in operating its owned facilities or even servicing its

assets in the near-term. The ownership of MPL has, in the opinion of

WMA, temporarily abandoned its assets for an unknown period of time.

"Manipulation" is a term that is particularly relevant to MPL and MPUI - the

companies having specific legal responsibilities which they have promised

in the past would be attended to. Conditions deteriorate and the promises

remain as unkept promises. Most notably, is the company's commitment

in the last general rate proceeding (i.e. Docket 2003-0115), to implement a

program to repair leaks. Since that commitment, it is estimated that the

potable water leakage has increased as much as 200%, or more. The

leakage has now been fairly well-documented – for the first time – by

WMA.

SPONSOR:

Lyle Dunham

#### MPU-IR-WMA-104 Ref: WMA Testimonv-1. p.2.1.19-23

Provide all documents and/or citations to support the following statements and comments on lines 19 to 23 in that paragraph:

- a. Legal obligation to provide water service.
- b. Identify the activities and procedures included in "land banking."
- c. Identify the activities that the complicated MPL's operations.
- d. Identify the activities that have made MPL's operations unduly expensive.
- e. Explain what property is being referred to and how and why that property may be forfeited.
- f. Identify all of the major challenges that are "faced" by the County, residents of the island of Molokai, the State government and WMA.
- g. Explain how each of the above elements are the responsibility of MPU and why they should be considered by the Commission in this rate application.

#### RESPONSE:

- a. HPUC Docket No. 4112, Decision & Order No. 6384, filed on October 29, 1981, and subsequent decisions, as well.
- b. "Landbanking" is not used in a technical term. However, due to the diminished activities throughout the Molokai Ranch and the Kaluakoi Resort Complexes, and the remainder of MPL's assets on the island of Molokai, many have concluded that the owner of MPL has ceased proceeding with any meaningful activities other than possibly items such as security guards, insurance, utility operations,

- and legal maneuvers to avoid performing any other services.
- c. MPL has begun to incur hundreds of thousands of dollars of legal services to ward off complaints by governmental agencies such as the County of Maui government and the Hawaii Public Utilities

  Commission, due to MPL/MPUI/Waiola O' Molokai earlier expressed intent to shut down operations. Under normal circumstances, these matters could possibly be discussed and resolved without the incurrence of unduly large legal expenses being incurred not only by MPL/MPUI/WOM, but by the County, WMA, the Consumer Advocate, and other governmental agencies, as well.
- d. Refer to Response to Sub-Part C, above.
- e. Any one or more of the property interests owned or controlled by MPL.
- f. Due to MPL's earlier announcement of ceasing water service, apparent landbanking of its properties, the County and the State wrestle with the issue of who will provide water to the residents of the West End of Molokai. Other challenges exist as well: what entity is going to maintain roads, ensure public safety, provide fire protection by means of an operable water systems/fire hydrants; minimize robberies, burglaries, poaching, hooliganism, etc. on facilities that have been shuddered and no longer in a usable state.
- g. MPU is one of the many subsidiaries of MPL. MPU appears to have little or no control over its decisions, without the approval of MPL. As an indicator of the general consensus of this opinion is

the fact that the Commission, in this proceeding, made MPL a party to the proceeding, knowing that any representation of MPU is unreliable and unenforceable without MPL's concurrence.

SPONSOR:

Lyle Dunham

#### MPU-IR-WMA-105 Ref; WMA Testimonv-1. p.3.1. 2-5

- a. Identify each of the "sources" of the "crisis situation" that the
   "shareholder" over time has committed that support a
   position that no return to the shareholder should be allowed.
- Provide copies of all documents submitted by WMA or any of its members to the Commission or other governmental agency showing any prior action related to the operation of MPU.
- c. Provide all evidence or documentation showing that past actions by MPU have created a crisis situation that would support denial of a return on investment to its shareholder.

#### **RESPONSE:**

- a. Refer to WMA's Response to MPU-IR-WMA-102, 103, and 104.
- b. The Information Request is not understood by WMA. As an Association, WMA attempted to intervene in HPUC Docket 2008-0115, but WMA's Petition was rejected. Also, refer to WMA's pleadings in this Docket.
- c. Refer to WMA's response MPU-IR-WMA 102 through 104.

#### SPONSOR:

Lyle Dunham

#### MPU-IR-WMA-106 Ref: WMA Testimonv-1. p. 5.1. 9-10

- a. Identify with specificity all data required by WMA that was not available to WMA.
  - Provide WMA's estimate of the one-time cost of providing this data.
  - Provide WMA's estimate of the ongoing cost of obtaining, preparing and monitoring the data requested.
- Provide all supporting documentation and calculations made
   by Mr. Dunham for the rates shown on Exhibit WMA-102.

#### RESPONSE:

- 1. It is WMA's belief that MPUI or its parent MPL must at a minimum have a computer-driven software system providing a modicum of essential data to conduct utility business, which data normally would have various cross-references, such as the number of customers, customer consumption, payment records, etc. To date, neither the Consumer Advocate nor WMA has received accurate customer counts or customer consumption data. (Refer, DCA Witness Nishina's Direct Testimony, pp. 20-25.)
- 2. WMA estimates that the ongoing costs of obtaining, preparing, entering, and monitoring such data would be minimal, and far, far less substantial than the legal costs being incurred by the company to either now collect the data or to prevent the disclosure of such information.
- b. As the statement contained in the Direct Testimony of Mr. Dunham makes clear, the documentation and results of operations exhibited

by Mr. Dunham were done by another, namely Witness Fujino.

SPONSOR: Lyle Dunham

#### MPU-IR-WMA-107 Ref: WMA Testimonv-2. p.5.1.19-22

Provide an estimate for the cost of developing a systematic plan for maintenance, repair and improvement.

- a. Provide an estimate for the cost of implementing the systematic plan.
- b. Is WMA prepared to pay for the costs of developing and operating under such a systematic plan?
- c. What does WMA believe is the timetable for such a plan?
- Identify all the system functions that WMA say "need repair and improvement."

RESPONSE: WMA cannot provide a cost estimate for the development of a systematic plan for maintenance, repairs and improvements because it does not know the extent and technical characteristics of the pipelines and facilities under consideration in sufficient detail. Although both WMA and the Consumer Advocate have requested studies, reports, construction drawings and similar descriptive information from MPU, nothing of consequence has been provided. WMA has issued the same information requests to MPL and the County of Maui in an attempt to compile a technical data base suitable for analysis by engineering and management consultants.

a. WMA cannot provide the requested cost estimate because the systematic plan itself has not been outlined, let alone developed and approved.

- b. To the extent that such costs are approved by the Public Utilities Commission and are included in this or some future rate structure, WMA members will ultimately bear such costs.
- c. WMA contends that some form of maintenance plan should have been established and implemented years ago! Even a simple written list of the "top ten" items, in order of priority, would be far superior to that which MPU claims to have (i.e., nothing). The complete lack of any maintenance plan is indicative of this firm's poor management. Furthermore, WMA asserts that the compilation of a technical data base suitable for analysis and planning purposes should have been completed by now and made available for consideration in these proceedings. The time table for any subsequent steps is contingent on the accuracy and comprehensiveness of whatever technical data base is made available for study and use.
- d. Again, without a clear and more complete understanding of the physical attributes and extent of the pipelines and facilities, WMA cannot identify ALL of the system functions in need of repair or improvement. However, some illustrative examples are presented below.
- (1) Well #17 Prime Mover. One of WMA's primary concerns is the status of the diesel engine presently installed at Well #17. This is,

by far, the most critical single component of the utility's water system because no backup or standby unit is in place. When the prime mover at Well #17 fails or is otherwise inoperative, the normal water supplies to Kualapuu and MPU's retail service area are shut down. Alternative sources of supply are extremely limited in terms of daily capacity and duration.

Based upon the public record in PUC Dockets 2002-0371, 2008-0115 and 2009-0048, the interval between replacement or major overhauls of the prime mover at Well #17 is approximately 45 months, on average, as per the recent history summarized below.

January 1966 New diesel engine installed

July-October 1999 Major failure and complete replacement

June 2004 Complete replacement. New Caterpillar

Model 3412E diesel engine installed

September 2007 Diesel engine breakdown.

Major overhaul performed onsite

November 2009 Well house cooling system installed

On the surface, the frequency of engine replacements seems excessive, and leads one to question the reasons for the breakdowns and failures.

Improper maintenance practices?

Improper engine selection for actual pump load (i.e., overloading)?

Improper engine selection for actual ambient conditions such as:

temperature, humidity and altitude (i.e., derating considerations)?

Improper engine selection for operational duty cycles (i.e., percent running time in a given interval)?

In its response to CA-IR-38, MPU asserts that it follows the manufacturer's guidelines for maintenance, where applicable. In its response to CA-SIR-9a, MPU states that it performs scheduled maintenance on the Well #17 engine every 300 running hours.

Recommended maintenance intervals for Caterpillar's Model 3412E diesel engine are: every 250, every 500, every 3,000 and every 5,000 service hours, as per the attached document downloaded from the manufacturer's web site. Maintenance actions specified for each interval are very detailed and straightforward. Notice that engine oil changes, engine oil filter replacements and engine air filter replacements are to be performed every 250 hours. Furthermore, the manufacturer states that the maintenance interval shall be determined by fuel

consumption, service hours, or calendar time, which ever occurs first.

However, a cursory analysis of the Well 17 logs provided in MPU's Attachment CA-IR-38a(2) clearly shows that the manufacturer's maintenance guidelines are NOT being followed. The engine's running time meter (RTM) indicated 10,878.3 hours after the major overhaul was completed on September 20, 2007. In the interval from 9-20-2007 through 7-13-2009, a total of eleven (11) oil changes were noted in the logs. Dates and service intervals, as determined from the engine's running time meter (RTM) readings, are as follows:

<u>Date</u>	RTM Interval
10-26-07	475.0 hours
11-26-07	363.5
01-10-08	373.4
02-14-08	367.3
03-20-08	382.9
05-01-08	432.8
06-16-08	380.0
08-11-08	446.7
12-01-08	701.2
02-26-09	560.7
07-13-09	650.4

As of 10-02-2009, the last entry in the logs, the engine had run 509.1

hours without scheduled maintenance. Furthermore, as of this date, the engine had accumulated approximately 5,642 hours of running time since the major overhaul completed on 09-20-2007, yet no mention is made in the logs of performing the 3,000 hour and 5,000 hour maintenance actions.

MPU's installation of additional well house cooling equipment suggests that the engine is overheating or is expected to overheat at some point. WMA is concerned that MPU's solution may be just a "band-aid" fix that obscures the underlying causes of the engine running hot, such as: timing errors, injectors not delivering enough fuel (mixture too lean), scale and rust in the cooling system, etc. Are there any drawings, calculations or sketches that substantiate the design objectives of the new equipment, or the installation thereof? Who prepared them? Has the arrangement been approved by an authorized factory-trained service representative employed by the manufacturer or one of its dealers?

- (2) Leaks. Find the major leaks in the distribution pipelines and repair them. If this task is beyond the capability of MPU's staff and/or local contractors, request proposals from firms specializing in this type of work.
  - (3) Automate Routine Data Collection. Explore the feasibility of automating routine data measurement, logging and recording functions. Modest investments for the

instrumentation of tank levels, valve positions, alarm set points and intrusion sensors, to name but a few, together with the installation of rf telemetry links and/or leased telephone lines between the remote facilities and a central computer may be cost effective alternatives to the manual data logging and recording methods presently in use. Reducing the number of man-hours spent driving around the countryside is, of course, the first objective. Secondary benefits are reduced expenses associated with the use of MPUs vehicles (i.e., fuel, repairs, maintenance, etc.). This suggestion may be more applicable to the Wai'ola O Molokai rate case since the Mountain Water System's watershed and reservoirs are much farther away from the office and are only accessible by 4-wheel drive vehicles over a long, unimproved truck trail.

SPONSOR Rot

Robert Marusich

# TO WMA'S RESPONSE TO MPU-IR-WMA-107(d)

**(35 PAGES)** 

3408E and 3412E INDUSTRIAL ENGINES Maintenance Intervals

Excerpted from Operation & Maintenance Manual (SEBU6960-04-01)

# Maintenance Interval Schedule (3408E Industrial Engine)

SMCS Code: 1000; 7500

**S/N:** 7PR1-Up

Before performing any operation or maintenance procedures, ensure that the Safety Information, warnings, and instructions are read and understood.

To determine the maintenance intervals, use fuel consumption, service hours, or calendar time, which ever occurs first.

Before each consecutive interval is performed, all of the maintenance requirements from the previous interval must also be performed.

Note: Some maintenance items are for optional equipment.

#### When Required

Battery - Replace
Daily
Cooling System Coolant Level - Check 85 Driven Equipment - Check 88 Engine Air Cleaner Service Indicator - Inspect 93 Engine Air Precleaner - Clean 94 Engine Oil Level - Check 95 Fuel System Primary Filter/Water Separator - Drain 100 Fuel Tank Water and Sediment - Drain 102 Power Take-Off Clutch - Check/Adjust/ Lubricate 107 Walk-Around Inspection 110
Every 3000 Service Hours or 3 Years
Cooling System Coolant (DEAC) - Change 82
Every 6000 Service Hours or 6 Years
Cooling System Coolant (ELC) - Change 84
First 13 000 L (3400 US gal) of Fuel or 250 Service Hours

Engine Valve Lash - Inspect/Adjust ...... 98

## Every 13 000 L (3400 US gal) of Fuel or 250 Service Hours

Aftercooler Core - Clean/Test
Every 26 000 L (6800 US gal) of Fuel or 500 Service Hours
Engine Crankcase Breather - Clean
Every 153 500 L (40 500 US gal) of Fuel or 3000 Service Hours
Air Compressor - Inspect
Every 256 000 L (67 500 US gal) of Fuel or 5000 Service Hours
Alternator - Inspect

Overhaul Considerations ...... 104

Overhaul



# Maintenance Interval Schedule (3412E Industrial Engine)

SMCS Code: 1000; 7500

**S/N:** 4CR1-Up **S/N:** BDT1-Up **S/N:** BFT1-Up

Before performing any operation or maintenance procedures, ensure that the Safety Information, warnings, and instructions are read and understood.

To determine the maintenance intervals, use fuel consumption, service hours, or calendar time, which ever occurs first.

Before each consecutive interval is performed, all of the maintenance requirements from the previous interval must also be performed.

Note: Some maintenance items are for optional equipment.

#### When Required

Battery - Replace
Severe Service Application - Check 108
Dally
Cooling System Coolant Level - Check 85 Driven Equipment - Check 88 Engine Air Cleaner Service Indicator - Inspect 93 Engine Air Precleaner - Clean 94 Engine Oil Level - Check 95 Fuel System Primary Filter/Water Separator - Drain 100 Fuel Tank Water and Sediment - Drain 102 Power Take-Off Clutch - Check/Adjust/ Lubricate 107 Walk-Around Inspection 110
Every 3000 Service Hours or 3 Years
Cooling System Coolant (DEAC) - Change 82
Every 6000 Service Hours or 6 Years
Cooling System Coolant (FLC) - Change 84

## First 19 000 L (5000 US gal) of Fuel or 250 Service Hours

Engine Valve Lash - Inspect/Adjust 98
---------------------------------------

## Every 19 000 L (5000 US gal) of Fuel or 250 Service Hours

Aftercooler Core - Clean/Test	79
Alternator and Fan Belts - Inspect/Adjust/	
Replace	80
Battery Electrolyte Level - Check	81
Cooling System Supplemental Coolant Additive	
(SCA) - Test/Add	86
Electronics Grounding Stud - Inspect/Clean/	
Tighten	88
Engine Air Cleaner Element (Dual Element) - Clean/Replace	89
Engine Air Cleaner Element (Single Element) - Replace	92
Engine Oil Sample - Obtain	
Engine Oil and Filter - Change	
Fan Drive Bearing - Lubricate	99
Fuel System Secondary Filter - Replace 1	
Hoses and Clamps - Inspect/Replace 1	103
Radiator - Clean 1	107

## Every 38 000 L (10 000 US gal) of Fuel or 500 Service Hours

Engine Crankcase Breather - Clean	. 94
Fuel System Primary Filter/Water Separator Elen	nent
- Replace	

## Every 228 000 L (60 000 US gal) of Fuel or 3000 Service Hours

Air Compressor - Inspect	79
Cooling System Coolant Extender (ELC) - Add	85
Cooling System Water Temperature Regulator -	
Replace	87
Crankshaft Vibration Damper - Inspect	
Engine - Clean	89
Engine Mounts - Inspect	95
Engine Speed/Timing Sensors - Check/Clean/	
Calibrate	98
Engine Valve Lash - Inspect/Adjust	
Engine Valve Rotators - Inspect	
<b>G</b>	

## Every 379 000 L (100 000 US gal) of Fuel or 5000 Service Hours

Alternator - Inspect	. 80
Starting Motor - Inspect	109
Turbocharger - Inspect	
Water Pump - Inspect	

#### Overhaul

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#### Aftercooler Core - Clean/Test

SMCS Code: 1064-070; 1064-081

Note: Adjust the frequency of cleaning according to the effects of the operating environment.

Inspect the aftercooler for these items: damaged fins, corrosion, dirt, grease, insects, leaves, oil, and other debris. Clean the aftercooler, if necessary.

For air-to-air aftercoolers, use the same methods that are used for cleaning radiators.

#### **WARNING**

Personal injury can result from air pressure.

Personal injury can result without following proper procedure. When using pressure air, wear a protective face shield and protective clothing.

Maximum air pressure at the nozzle must be less than 205 kPa (30 psi) for cleaning purposes.

Pressurized air is the preferred method for removing loose debris. Direct the air in the opposite direction of the air flow from the fan. Hold the nozzle approximately 6 mm (.25 inch) away from the fins. Slowly move the air nozzle in a direction that is parallel with the tubes. This will remove debris that is between the tubes.

Pressurized water may also be used for cleaning. The maximum water pressure for cleaning purposes must be less than 275 kPa (40 psi). Use pressurized water in order to soften mud. Clean the core from both sides.

Use a degreaser and steam for removal of oil and grease. Clean both sides of the core. Wash the core with detergent and hot water. Thoroughly rinse the core with clean water.

Inspect the fins for damage. Bent fins may be opened with a "comb".

Note: If parts of the aftercooler system are repaired or replaced, a leak test is highly recommended.

Inspect these items for good condition: welds, mounting brackets, air lines, connections, clamps, and seals. Make repairs, if necessary.

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## **Air Compressor - Inspect**

SMCS Code: 1803-040

#### **A WARNING**

Do not disconnect the air line from the air compressor governor without purging the air brake and the auxiliary air systems. Failure to purge the air brake and the auxiliary air systems before removing the air compressor and/or the air lines could cause personal injury.

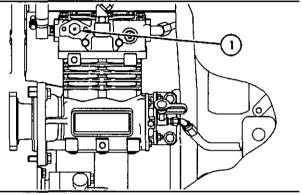


Illustration 31

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(1) Air compressor pressure relief valve

#### **A** WARNING

If the air compressor pressure relief valve that is mounted in the air compressor cylinder head is bypassing compressed air, there is a malfunction in the air system, possibly ice blockage. Under these conditions, your engine may have insufficient air for normal brake operation.

Do not operate the engine until the reason for the air bypass is identified and corrected. Failure to heed this warning could lead to property damage, personal injury, or death to the operator or bystanders.

The function of the air compressor pressure relief valve is to bypass air when there is a malfunction in the air compressor system.

The air compressor pressure relief valve releases air at 1723 kPa (250 psi). It is very important that all personnel stand clear of the air compressor pressure relief valve when compressed air is released. All personnel should also stay clear of the air compressor when the engine is operating and the air compressor is exposed.

Refer to the Service Manual or refer to the OEM specifications in order to find information concerning the air compressor. Consult your Caterpillar dealer for assistance.

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## **Alternator - Inspect**

SMCS Code: 1405-040

Caterpillar recommends a scheduled inspection of the alternator. Inspect the alternator for loose connections and proper battery charging. Inspect the ammeter (if equipped) during engine operation in order to ensure proper battery performance and/or proper performance of the electrical system. Make repairs, as required. Refer to the Service Manual.

Check the alternator and the battery charger for proper operation. If the batteries are properly charged, the ammeter reading should be very near zero. All batteries should be kept charged. The batteries should be kept warm because temperature affects the cranking power. If the battery is too cold, the battery will not crank the engine. The battery will not crank the engine is warm. When the engine is not run for long periods of time or if the engine is run for short periods, the batteries may not fully charge. A battery with a low charge will freeze more easily than a battery with a full charge.

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# Alternator and Fan Belts - Inspect/Adjust/Replace

SMCS Code: 1357-039

## Inspection

To maximize the engine performance, inspect the belts for wear and for cracking. Check the belt tension. Adjust the belt tension in order to minimize belt slippage. Belt slippage will decrease the life of the belts.

To check the belt tension, apply 110 N (25 lb) of force midway between the pulleys. A correctly adjusted belt will deflect 13 to 19 mm (0.50 to 0.75 inch).

#### **Adjustment**

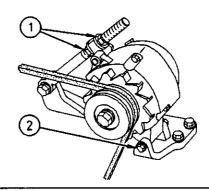


Illustration 32

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Typical illustration: (1) Adjusting nuts. (2) Mounting bolts.

- Remove the belt guard.
- 2. Loosen mounting bolt (2) and adjusting nuts (1).
- Turn adjusting nuts (1) in order to increase or decrease the belt tension.
- Tighten adjusting nuts (1). Tighten mounting bolt (2). Refer to the Operation and Maintenance Manual for the proper torques.

If new belts are installed, check the tension again after 30 minutes of engine operation at the rated rpm.

#### Replacement

For applications that require multiple drive belts, replace the belts in matched sets. Replacing only one belt of a matched set will cause the new belt to carry more load because the older belt is stretched. The additional load on the new belt could cause the new belt to break.

Refer to the Service Manual for more information on the procedures for the following topics: belt removal and belt installation procedure.

## **Battery - Replace**

SMCS Code: 1401-510

#### **A WARNING**

Batteries give off combustible gases which can explode. A spark can cause the combustible gases to ignite. This can result in severe personal injury or death.

Ensure proper ventilation for batteries that are in an enclosure. Follow the proper procedures in order to help prevent electrical arcs and/or sparks near batteries. Do not smoke when batteries are serviced.

#### **WARNING**

The battery cables or the batteries should not be removed with the battery cover in place. The battery cover should be removed before any servicing is attempted.

Removing the battery cables or the batteries with the cover in place may cause a battery explosion resulting in personal injury.

- Turn the key start switch to the OFF position. Remove the key and all electrical loads.
- 2. Turn OFF the battery charger. Disconnect the charger.
- The NEGATIVE "-" cable connects the NEGATIVE "-" battery terminal to the ground plane. Disconnect the cable from the NEGATIVE "-" battery terminal.
- 4. The POSITIVE "+" cable connects the POSITIVE "+" battery terminal to the starting motor. Disconnect the cable from the POSITIVE "+" battery terminal.

Note: Always recycle a battery. Never discard a battery. Return used batteries to an appropriate recycling facility.

- 5. Remove the used battery.
- 6. Install the new battery.

Note: Before the cables are connected, ensure that the key start switch is OFF.

7. Connect the cable from the starting motor to the POSITIVE "+" battery terminal.

Connect the cable from the ground plane to the NEGATIVE "-" battery terminal.

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# Battery Electrolyte Level - Check

SMCS Code: 1401-535

When the engine is not run for long periods of time or when the engine is run for short periods, the batteries may not fully recharge. Ensure a full charge in order to help prevent the battery from freezing. If batteries are properly charged, ammeter reading should be very near zero.

#### **WARNING**

All lead-acid batteries contain sulfuric acid which can burn the skin and clothing. Always wear a face shield and protective clothing when working on or near batteries.

 Remove the filler caps. Maintain the electrolyte level to the "FULL" mark on the battery.

If the addition of water is necessary, use distilled water. If distilled water is not available use clean water that is low in minerals. Do not use artificially softened water.

- Check the condition of the electrolyte with the 1U-7298 Coolant/Battery Tester (°C) or the 1U-7297 Coolant/Battery Tester (°F).
- 3. Keep the batteries clean.

Clean the battery case with one of the following cleaning solutions:

- A mixture of 0.1 kg (0.2 lb) of baking soda and 1 L (1 qt) of clean water
- A mixture of 0.1 L (0.11 qt) of ammonia and 1 L (1 qt) of clean water

Thoroughly rinse the battery case with clean water.

Use a fine grade of sandpaper to clean the terminals and the cable clamps. Clean the items until the surfaces are bright or shiny. DO NOT remove material excessively. Excessive removal of material can cause the clamps to not fit properly. Coat the clamps and the terminals with 5N-5561 Silicone Lubricant, petroleum jelly or MPGM grease.

# Battery or Battery Cable - Disconnect

**SMCS Code:** 1402-029

#### **MARNING**

The battery cables or the batteries should not be removed with the battery cover in place. The battery cover should be removed before any servicing is attempted.

Removing the battery cables or the batteries with the cover in place may cause a battery explosion resulting in personal injury.

- Turn the start switch to the OFF position. Turn the ignition switch (if equipped) to the OFF position and remove the key and all electrical loads.
- Disconnect the negative battery terminal at the battery that goes to the start switch. Ensure that the cable cannot contact the terminal. When four 12 volt batteries are involved, the negative side of two batteries must be disconnected.
- Tape the leads in order to help prevent accidental starting.
- Proceed with necessary system repairs. Reverse the steps in order to reconnect all of the cables.

i01206425

# Cooling System Coolant (DEAC) - Change

SMCS Code: 1350-070; 1395-044

Clean the cooling system and flush the cooling system before the recommended maintenance interval if the following conditions exist:

- The engine overheats frequently.
- Foaming is observed.
- The oil has entered the cooling system and the coolant is contaminated.
- The fuel has entered the cooling system and the coolant is contaminated.

#### NOTICE

Use of commercially available cooling system cleaners may cause damage to cooling system components. Use only cooling system cleaners that are approved for Caterpillar engines.

Note: Inspect the water pump and the water temperature regulator after the cooling system has been drained. This is a good opportunity to replace the water pump, the water temperature regulator and the hoses, if necessary.

#### Drain

#### **A** WARNING

Pressurized System: Hot coolant can cause serious burns. To open the cooling system filler cap, stop the engine and wait until the cooling system components are cool. Loosen the cooling system pressure cap slowly in order to relieve the pressure.

- Stop the engine and allow the engine to cool. Loosen the cooling system filler cap slowly in order to relieve any pressure. Remove the cooling system filler cap.
- Open the cooling system drain valve (if equipped). If the cooling system is not equipped with a drain valve, remove one of the drain plugs.

Allow the coolant to drain.

#### NOTICE

Dispose of used engine coolant properly or recycle. Various methods have been proposed to reclaim used coolant for reuse in engine cooling systems. The full distillation procedure is the only method acceptable by Caterpillar to reclaim the used coolant.

For information regarding the disposal and the recycling of used coolant, consult your Caterpillar dealer or consult Caterpillar Service Technology Group:

Outside Illinois: 1-800-542-TOOL Inside Illinois: 1-800-541-TOOL Canada: 1-800-523-TOOL

#### Flush

 Flush the cooling system with clean water in order to remove any debris. Close the drain valve (if equipped). Clean the drain plugs. Install the drain plugs. Refer to the Operation and Maintenance Manual, "Torque Specifications" topic (Maintenance Section) for more information on the proper torques.

#### NOTICE

Fill the cooling system no faster than 19 L (5 US gal) per minute to avoid air locks.

- 3. Fill the cooling system with a mixture of clean water and Caterpillar Fast Acting Cooling System Cleaner. Add 0.5 L (1 pint) of cleaner per 15 L (4 US gal) of the cooling system capacity. Install the cooling system filler cap.
- Start and run the engine at low idle for a minimum of 30 minutes. The coolant temperature should be at least 82 °C (180 °F).

#### NOTICE

Improper or incomplete rinsing of the cooling system can result in damage to copper and other metal components.

To avoid damage to the cooling system, make sure to completely flush the cooling system with clear water. Continue to flush the system until all signs of the cleaning agent are gone.

5. Stop the engine and allow the engine to cool. Loosen the cooling system filler cap slowly in order to relieve any pressure. Remove the cooling system filler cap. Open the drain valve (if equipped) or remove the cooling system drain plugs. Allow the water to drain. Flush the cooling system with clean water. Close the drain valve (if equipped). Clean the drain plugs. Install the drain plugs. Refer to the Operation and Maintenance Manual, "Torque Specifications" topic (Maintenance Section) for more information on the proper torques.

#### Cooling Systems with Heavy Deposits or Plugging

Note: For the following procedure to be effective, there must be some active flow through the cooling system components.

- Flush the cooling system with clean water in order to remove any debris.
- Close the drain valve (if equipped). Clean the drain plugs. Install the drain plugs. Refer to the Operation and Maintenance Manual, "Torque Specifications" topic (Maintenance Section) for more information on the proper torques.

#### NOTICE

Fill the cooling system no faster than 19 L (5 US gal) per minute to avoid air locks.

- 3. Fill the cooling system with a mixture of clean water and Caterpillar Fast Acting Cooling System Cleaner. Add 0.5 L (1 pint) of cleaner per 3.8 to 7.6 L (1 to 2 US gal) of the cooling system capacity. Install the cooling system filler cap.
- Start and run the engine at low idle for a minimum of 90 minutes. The coolant temperature should be at least 82 °C (180 °F).

#### NOTICE

Improper or incomplete rinsing of the cooling system can result in damage to copper and other metal components.

To avoid damage to the cooling system, make sure to completely flush the cooling system with clear water. Continue to flush the system until all signs of the cleaning agent are gone.

5. Stop the engine and allow the engine to cool. Loosen the cooling system filler cap slowly in order to relieve any pressure. Remove the cooling system filler cap. Open the drain valve (if equipped) or remove the cooling system drain plugs. Allow the water to drain. Flush the cooling system with clean water. Close the drain valve (if equipped). Clean the drain plugs. Install the drain plugs. Refer to the Operation and Maintenance Manual, "Torque Specifications" topic (Maintenance Section) for more information on the proper torques.

#### Fill

#### NOTICE

Fill the cooling system no faster than 19 L (5 US gal) per minute to avoid air locks.

- Fill the cooling system with coolant/antifreeze. Refer to the Operation and Maintenance Manual, "Cooling System Specifications" topic (Maintenance Section) for more information on cooling system specifications. Do not install the cooling system filler cap.
- 2. Start and run the engine at low idle. Increase the engine rpm to 1500 rpm. Run the engine at high idle for one minute in order to purge the air from the cavities of the engine block. Stop the engine.

- Check the coolant level. Maintain the coolant level within 13 mm (0.5 inch) below the bottom of the pipe for filling. Maintain the coolant level within 13 mm (0.5 inch) to the proper level on the sight glass (if equipped).
- 4. Clean the cooling system filler cap. Inspect the gasket that is on the cooling system filler cap. If the gasket that is on the cooling system filler cap is damaged, discard the old cooling system filler cap and install a new cooling system filler cap. If the gasket that is on the cooling system filler cap is not damaged, perform a pressure test. A 9S-8140 Pressurizing Pump is used to perform the pressure test. The correct pressure for the cooling system filler cap is stamped on the face of the cooling system filler cap. If the cooling system filler cap does not retain the correct pressure, install a new cooling system filler cap.
- **5.** Start the engine. Inspect the cooling system for leaks and for proper operating temperature.

# Cooling System Coolant (ELC) - Change

SMCS Code: 1350-070; 1395-044

Clean the cooling system and flush the cooling system before the recommended maintenance interval if the following conditions exist:

- The engine overheats frequently.
- Foaming is observed.
- The oil has entered the cooling system and the coolant is contaminated.
- The fuel has entered the cooling system and the coolant is contaminated.

Note: When the cooling system is cleaned, only clean water is needed when the ELC is drained and replaced.

Note: Inspect the water pump and the water temperature regulator after the cooling system has been drained. This is a good opportunity to replace the water pump, the water temperature regulator and the hoses, if necessary.

#### Drain

#### **MARNING**

Pressurized System: Hot coolant can cause serious burns. To open the cooling system filler cap, stop the engine and wait until the cooling system components are cool. Loosen the cooling system pressure cap slowly in order to relieve the pressure.

- Stop the engine and allow the engine to cool. Loosen the cooling system filler cap slowly in order to relieve any pressure. Remove the cooling system filler cap.
- Open the cooling system drain valve (if equipped). If the cooling system is not equipped with a drain valve, remove the cooling system drain plugs.

Allow the coolant to drain.

#### NOTICE

Dispose of used engine coolant properly or recycle. Various methods have been proposed to reclaim used coolant for reuse in engine cooling systems. The full distillation procedure is the only method acceptable by Caterpillar to reclaim the used coolant.

For information regarding the disposal and the recycling of used coolant, consult your Caterpillar dealer or consult Caterpillar Service Technology Group:

Outside Illinois: 1-800-542-TOOL Inside Illinois: 1-800-541-TOOL Canada: 1-800-523-TOOL

#### Flush

- Flush the cooling system with clean water in order to remove any debris.
- 2. Close the drain valve (if equipped). Clean the drain plugs. Install the drain plugs. Refer to the Operation and Maintenance Manual, "Torque Specifications" topic (Maintenance Section) for more information on the proper torques.

#### NOTICE

Fill the cooling system no faster than 19 L (5 US gal) per minute to avoid air locks.

3. Fill the cooling system with clean water. Install the cooling system filler cap.

- Start and run the engine at low idle until the temperature reaches 49 to 66 °C (120 to 150 °F).
- 5. Stop the engine and allow the engine to cool. Loosen the cooling system filler cap slowly in order to relieve any pressure. Remove the cooling system filler cap. Open the drain valve (if equipped) or remove the cooling system drain plugs. Allow the water to drain. Flush the cooling system with clean water. Close the drain valve (if equipped). Clean the drain plugs. Install the drain plugs. Refer to the Operation and Maintenance Manual, "Torque Specifications" topic (Maintenance Section) for more information on the proper torques.

#### Fill

#### NOTICE

Fill the cooling system no faster than 19 L (5 US gal) per minute to avoid air locks.

- Fill the cooling system with Extended Life Coolant (ELC). Refer to the Operation and Maintenance Manual, "Cooling System Specifications" topic (Maintenance Section) for more information on cooling system specifications. Do not install the cooling system filler cap.
- Start and run the engine at low idle. Increase the engine rpm to high idle. Run the engine at high idle for one minute in order to purge the air from the cavities of the engine block. Stop the engine.
- Check the coolant level. Maintain the coolant level within 13 mm (0.5 inch) below the bottom of the pipe for filling. Maintain the coolant level within 13 mm (0.5 inch) to the proper level on the sight glass (if equipped).
- 4. Clean the cooling system filler cap. Inspect the gasket that is on the cooling system filler cap. If the gasket that is on the cooling system filler cap is damaged, discard the old cooling system filler cap and install a new cooling system filler cap. If the gasket that is on the cooling system filler cap is not damaged, use a 9S-8140 Pressurizing Pump in order to pressure test the cooling system filler cap. The correct pressure for the cooling system filler cap is stamped on the face of the cooling system filler cap does not retain the correct pressure, install a new cooling system filler cap.
- **5.** Start the engine. Inspect the cooling system for leaks and for proper operating temperature.

i00259474

# Cooling System Coolant Extender (ELC) - Add

SMCS Code: 1352-045; 1395-081

Caterpillar Extended Life Coolant (ELC) does not require the frequent Supplemental Coolant Additive (SCA) additions associated with the present conventional coolants. The Extender only needs to be added once.

Check the cooling system only when the engine is stopped and cool.

- Loosen the cooling system filler cap slowly in order to relieve pressure. Remove the cooling system filler cap.
- It may be necessary to drain enough coolant from the cooling system in order to add the Extender.
- 3. Add Extender according to the requirements for your engine's cooling system capacity. Refer to the Operation and Maintenance Manual, "Refill Capacities" in the Maintenance Section for the capacity of the cooling system for your engine. Refer to the Operation and Maintenance Manual, "Cooling System Specifications" information for the Caterpillar ELC Extender additions.
- 4. Clean the cooling system filler cap. Inspect the cooling system filler cap gaskets. Replace the cooling system filler cap if the cooling system filler cap gaskets are damaged. Install the cooling system filler cap.

i01197583

# Cooling System Coolant Level - Check

SMCS Code: 1395-082

Check the coolant level when the engine is stopped and cool.

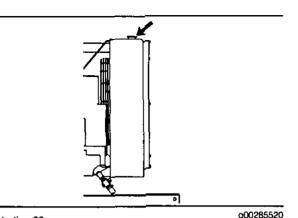


Illustration 33

guu285520

Cooling system filler cap

#### **A WARNING**

Pressurized System: Hot coolant can cause serious burns. To open the cooling system filler cap, stop the engine and wait until the cooling system components are cool. Loosen the cooling system pressure cap slowly in order to relieve the pressure.

- Remove the cooling system filler cap slowly in order to relieve pressure.
- Maintain the coolant level within 13 mm (0.5 inch) of the bottom of the filler pipe. If the engine is equipped with a sight glass, maintain the coolant level to the proper level in the sight glass.

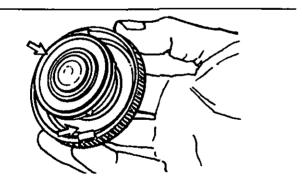


Illustration 34

g00103639

Typical filler cap gaskets

- Clean the cooling system filler cap and check the condition of the filler cap gaskets. Replace the cooling system filler cap if the filler cap gaskets are damaged. Reinstall the cooling system filler cap.
- Inspect the cooling system for leaks.

101463635

# Cooling System Supplemental Coolant Additive (SCA) - Test/Add

SMCS Code: 1352-045; 1395-081

#### **WARNING**

Cooling system coolant additive contains alkali. To help prevent personal injury, avoid contact with the skin and the eyes. Do not drink cooling system coolant additive.

Note: Test the concentration of the Supplemental Coolant Additive (SCA) or test the SCA concentration as part of an S·O·S Coolant Analysis.

#### **Test for SCA Concentration**

#### Coolant/Antifreeze and SCA

#### NOTICE

Do not exceed the recommended six percent supplemental coolant additive concentration.

Use the 8T-5296 Coolant Conditioner Test Kit or use the 4C-9301 Coolant Conditioner Test Kit in order to check the concentration of the SCA. Refer to the Operation and Maintenance Manual for more information.

#### Water and SCA

#### NOTICE

Do not exceed the recommended eight percent supplemental coolant additive concentration.

Test the concentration of the SCA with the 8T-5296 Coolant Conditioner Test Kit. Refer to the Operation and Maintenance Manual, "Water/Supplemental Coolant Additive (SCA)" topic (Maintenance Section). Refer to the Operation and Maintenance Manual, "Conventional Coolant/Antifreeze Cooling System Maintenance" topic (Maintenance Section).

## S-O-S Coolant Analysis

S·O·S coolant samples can be analyzed at your Caterpillar dealer. S·O·S Coolant Analysis is a program that is based on periodic samples.

#### Level 1

Level 1 is a basic analysis of the coolant. The following items are tested:

- Glycol Concentration
- Concentration of SCA
- pH
- Conductivity

The results are reported, and recommendations are made according to the results. Consult your Caterpillar dealer for information on the benefits of managing your equipment with an S-O-S Coolant Analysis.

#### Level 2

This level coolant analysis is recommended when the engine is overhauled. Refer to the Operations and Maintenance Manual, "Overhaul Considerations" for further information.

#### Add the SCA, If Necessary

#### NOTICE

Do not exceed the recommended amount of supplemental coolant additive concentration. Excessive supplemental coolant additive concentration can form deposits on the higher temperature surfaces of the cooling system, reducing the engine's heat transfer characteristics. Reduced heat transfer could cause cracking of the cylinder head and other high temperature components. Excessive supplemental coolant additive concentration could also result in radiator tube blockage, overheating, and/or accelerated water pump seal wear. Never use both liquid supplemental coolant additive and the spin-on element (if equipped) at the same time. The use of those additives together could result in supplemental coolant additive concentration exceeding the recommended maximum.

## **M** WARNING

Pressurized System: Hot coolant can cause serious burns. To open the cooling system filler cap, stop the engine and wait until the cooling system components are cool. Loosen the cooling system pressure cap slowly in order to relieve the pressure.

 Slowly loosen the cooling system filler cap in order to relieve the pressure. Remove the cooling system filler cap. Note: Always discard drained fluids according to local regulations.

- If necessary, drain some coolant from the cooling system into a suitable container in order to allow space for the extra SCA.
- Add the proper amount of SCA. Refer to the Operation and Maintenance Manual for more information on SCA requirements.
- 4. Clean the cooling system filler cap. Inspect the gaskets of the cooling system filler cap. If the gaskets are damaged, replace the old cooling system filler cap with a new cooling system filler cap. Install the cooling system filler cap.

100912898

## Cooling System Water Temperature Regulator - Replace

SMCS Code: 1355-510

Replace the water temperature regulator before the water temperature regulator fails. This is a recommended preventive maintenance practice. Replacing the water temperature regulator reduces the chances for unscheduled downtime.

A water temperature regulator that fails in a partially opened position can cause overheating or overcooling of the engine.

A water temperature regulator that fails in the closed position can cause excessive overheating. Excessive overheating could result in cracking of the cylinder head or piston seizure problems.

A water temperature regulator that fails in the open position will cause the engine operating temperature to be too low during partial load operation. Low engine operating temperatures during partial loads could cause an excessive carbon buildup inside the cylinders. This excessive carbon buildup could result in an accelerated wear of the piston rings and wear of the cylinder liner.

#### NOTICE

Failure to replace your water temperature regulator on a regularly scheduled basis could cause severe engine damage.

Caterpillar engines incorporate a shunt design cooling system and require operating the engine with a water temperature regulator installed.

If the water temperature regulator is installed incorrectly, the engine may overheat, causing cylinder head damage. Ensure that the new water temperature regulator is installed in the original position. Ensure that the water temperature regulator vent hole is open.

Do not use liquid gasket material on the gasket or cylinder head surface.

Refer to the Service Manual for the replacement procedure of the water temperature regulator, or consult your Caterpillar dealer.

Note: If only the water temperature regulators are replaced, drain the coolant from the cooling system to a level that is below the water temperature regulator housing.

i00072369

# Crankshaft Vibration Damper - Inspect

SMCS Code: 1205-040

Damage to the crankshaft vibration damper or failure of the crankshaft vibration damper can increase torsional vibrations. This can result in damage to the crankshaft and to other engine components. A deteriorating damper can cause excessive gear train noise at variable points in the speed range.

The damper is mounted to the crankshaft which is located behind the belt guard on the front of the engine.

#### Removal and Installation

Refer to the Service Manual for the damper removal procedure and for the damper installation procedure.

#### **Visconic Damper**

The visconic damper has a weight that is located inside a fluid filled case. The weight moves in the case in order to limit torsional vibration. Inspect the damper for evidence of dents, cracks or leaks of the fluid.

Replace the damper if the damper is dented, cracked or leaking. Refer to the Service Manual or consult your Caterpillar dealer for damper replacement.

i00174798

## **Driven Equipment - Check**

SMCS Code: 3279-535

Refer to the OEM specifications for more information on the following maintenance recommendations for the driven equipment:

- Inspection
- Adjustment
- Lubrication
- Other maintenance recommendations

Perform any maintenance for the driven equipment which is recommended by the OEM.

101646937

# Electronics Grounding Stud - Inspect/Clean/Tighten

SMCS Code: 7423-040; 7423-070; 7423-079

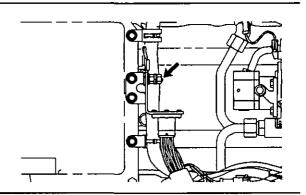


Illustration 35

Typical example

Electrical grounding stud (top view)

900395898

Inspect the wiring harnesses for good connections and condition.

The electrical grounding stud must have a wire ground to the battery. Tighten the electrical grounding stud at every oil change. Ground wires and straps should be combined at engine grounds. All grounds should be tight and free of corrosion.

- Clean the electrical grounding stud and the terminals for the electrical ground strap with a clean cloth.
- If the connections are corroded, clean the connections with a solution of baking soda and water.
- Keep the electrical grounding stud and the strap clean and coated with MPGM grease or petroleum jelly.

i01646701

## **Engine - Clean**

**SMCS Code:** 1000-070

#### **WARNING**

Personal injury or death can result from high voltage.

Moisture can create paths of electrical conductivity.

Make sure that the electrical system is OFF. Lock out the starting controls and tag the controls "DO NOT OPERATE".

#### NOTICE

Accumulated grease and oil on an engine is a fire hazard. Keep the engine clean. Remove debris and fluid spills whenever a significant quantity accumulates on the engine.

Periodic cleaning of the engine is recommended. Steam cleaning the engine will remove accumulated oil and grease. A clean engine provides the following benefits:

- Easy detection of fluid leaks
- Maximum heat transfer characteristics
- Ease of maintenance

Note: Caution must be used in order to prevent electrical components from being damaged by excessive water when you clean the engine. Avoid electrical components such as the alternator, the starter, and the ECM.

i01089660

# Engine Air Cleaner Element (Dual Element) - Clean/Replace

SMCS Code: 1054-037; 1054-510

Perform the Operation and Maintenance Manual, "Engine Air Cleaner Service Indicator-Inspect" procedure and perform the Operation and Maintenance Manual, "Engine Air Precleaner Check/Clean" procedure (if equipped) before performing the following procedure.

#### NOTICE

Never run the engine without an air cleaner element installed. Never run the engine with a damaged air cleaner element. Do not use air cleaner elements with damaged pleats, gaskets or seals. Dirt entering the engine causes premature wear and damage to engine components. Air cleaner elements help to prevent airborne debris from entering the air inlet.

#### NOTICE

Never service the air cleaner element with the engine running since this will allow dirt to enter the engine.

## **Servicing the Air Cleaner Elements**

If the air cleaner element becomes plugged, the air can split the material of the air cleaner element. Unfiltered air will drastically accelerate internal engine wear. Your Caterpillar dealer has the proper air cleaner elements for your application. Consult your Caterpillar dealer for the correct air cleaner element.

- Check the precleaner (if equipped) daily for accumulation of dirt and debris. Remove any dirt and debris, as needed.
- Operating conditions (dust, dirt and debris) may require more frequent service of the air cleaner element.
- The air cleaner element may be cleaned up to six times if the element is properly cleaned and inspected.

 The air cleaner element should be replaced at least one time per year. This replacement should be performed regardless of the number of cleanings.

Replace the dirty paper air cleaner elements with clean air cleaner elements. Before installation, the air cleaner elements should be thoroughly checked for tears and/or holes in the filter material. Inspect the gasket or the seal of the air cleaner element for damage. Maintain a supply of suitable air cleaner elements for replacement purposes.

#### **Air Cleaners With Dual Elements**

An air cleaner with a dual element contains a primary air cleaner element and a secondary air cleaner element. The primary air cleaner element can be used up to six times if the element is properly cleaned and inspected. The primary air cleaner element should be replaced at least one time per year. This replacement should be performed regardless of the number of cleanings.

The secondary air cleaner element is not serviceable or washable. The secondary air cleaner element should be removed and discarded for every three cleanings of the primary air cleaner element. When the engine is operating in environments that are dusty or dirty, air cleaner elements may require more frequent replacement.

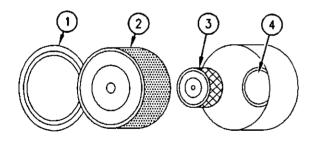


Illustration 36

g00123209

(1) Cover. (2) Primary air cleaner element. (3) Secondary air cleaner element. (4) Turbocharger air inlet.

- Remove the cover. Remove the primary air cleaner element.
- The secondary air cleaner element should be removed and discarded for every three cleanings of the primary air cleaner element.

Note: Refer to "Cleaning the Primary Air Filter Elements".

- Cover the turbocharger air inlet with tape in order to keep dirt out.
- 4. Clean the inside of the air cleaner cover and body with a clean, dry cloth.
- Remove the tape for the turbocharger air inlet. Install the secondary air cleaner element. Install a primary air cleaner element that is new or cleaned.
- 6. Install the air cleaner cover.
- Reset the service indicator.

#### Cleaning the Primary Air Cleaner Elements

The primary air cleaner element can be used up to six times if the element is properly cleaned and inspected. When the primary air cleaner element is cleaned, check for rips or tears in the filter material. The primary air cleaner element should be replaced at least one time per year. This replacement should be performed regardless of the number of cleanings.

Use clean primary air cleaner elements while dirty elements are being cleaned.

#### NOTICE

Do not clean the air cleaner elements by bumping or tapping. This could damage the seals. Do not use elements with damaged pleats, gaskets or seals. Damaged elements will allow dirt to pass through. Engine damage could result.

Visually inspect the primary air cleaner elements before cleaning. Inspect the air cleaner elements for damage to the seal, the gaskets, and the outer cover. Discard any damaged air cleaner elements.

There are four common methods that are used to clean primary air cleaner elements:

- Pressurized water
- Pressurized air
- Vacuum cleaning
- Washing with nonsudsing detergent

#### **Pressurized Water**

Pressurized water will clean the primary air cleaner element unless carbon and oil have accumulated on the surface of the primary air cleaner element. The maximum water pressure for cleaning purposes must be below 275 kPa (40 psi). Do not use a spray nozzle.

Note: When the primary air cleaner element is cleaned, always begin with the clean side (inside) in order to force dirt particles toward the dirty side (outside).

Aim the hose so that the water flows inside the element along the length of the filter in order to help prevent damage to the paper pleats. Do not aim the stream of water directly at the primary air cleaner element. Dirt could be forced further into the pleats.

Note: Refer to "Drying the Primary Air Cleaner Elements". Refer to "Inspecting the Primary Air Cleaner Elements".

#### **Pressurized Air**

Pressurized air can be used to clean primary air cleaner elements that have not been cleaned more than two times. Pressurized air will not remove deposits of carbon and oil. Use filtered, dry air with a maximum pressure of 207 kPa (30 psi).

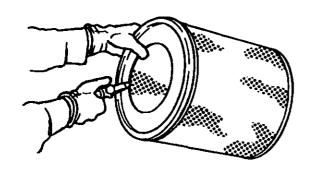


Illustration 37

g00281692

Note: When the primary air cleaner elements are cleaned, always begin with the clean side (inside) in order to force dirt particles toward the dirty side (outside).

Aim the hose so that the air flows inside the element along the length of the filter in order to help prevent damage to the paper pleats. Do not aim the stream of air directly at the primary air cleaner element. Dirt could be forced further into the pleats.

Note: Refer to "Inspecting the Primary Air Cleaner Elements".

#### **Vacuum Cleaning**

Vacuum cleaning is a good method for cleaning primary air cleaner elements which require daily cleaning because of a dry, dusty environment. Cleaning with pressurized air is recommended prior to vacuum cleaning. Vacuum cleaning will not remove deposits of carbon and oil.

Note: Refer to "Inspecting the Primary Air Cleaner Elements".

# Washing the Primary Air Cleaner Elements with Nonsudsing Detergent

#### **A** WARNING

Do not wash air cleaner elements in any flammable solution such as diesel fuel or gasoline. Doing so can cause fire or an engine runaway and can result in personal injury.

Washing with nonsudsing detergent is effective for cleaning primary air cleaner elements that have deposits of carbon or oil. Use a cleaning agent that is specifically manufactured for cleaning primary air cleaner elements. Cleaning with pressurized water, pressurized air, or a vacuum is recommended prior to washing with nonsudsing detergent.

 Place the primary air cleaner element into a wash tank so that the gasket is up. The wash tank should be equipped with a rack so that the primary air cleaner element does not sit on the bottom of the wash tank.

Note: Caterpillar does not recommend a process for washing the primary air cleaner element which includes vigorously shaking. By vigorously shaking the element, carbon particles may be distributed.

- 2. Fill the wash tank with the cleaning agent and warm water to a maximum temperature of 60°C (140°F). Follow the manufacturers recommendations for the cleaning agent. Allow the primary air cleaner element to soak for six hours.
- 3. Drain the wash tank. Do not use the cleaning agent more than one time. Remove the primary air cleaner element from the wash tank. Rinse the primary air cleaner element with the method for using pressurized water.

Note: Refer to "Drying the Primary Air Cleaner Elements". Refer to "Inspecting the Primary Air Cleaner Elements".

#### **Drying the Primary Air Cleaner Elements**

The oven method may be used in order to dry primary air cleaner elements. If an oven is used, do not expose the primary air cleaner elements to temperatures that exceed 82°C (160°F).

Note: Do not use compressed air in order to dry the primary air cleaner elements.

Primary air cleaner elements may be allowed to air dry. Allow two days for the primary air cleaner elements to air dry before the elements are inspected and installed.

## Inspecting the Primary Air Cleaner Elements

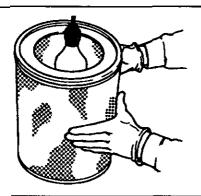


Illustration 38

g00281693

Inspect the clean, dry primary air cleaner element. Use a 60 watt blue light in a dark room or in a similar facility. Place the blue light in the primary air cleaner element. Rotate the primary air cleaner element. Inspect the primary air cleaner element for tears and/or holes. Inspect the primary air cleaner element for light that may show through the filter material. If it is necessary in order to confirm the result, compare the primary air cleaner element to a new primary air cleaner element that has the same part number.

Do not use a primary air cleaner element that has any tears and/or holes in the filter material. Do not use an primary air cleaner element with damaged pleats, gaskets or seals. Discard damaged primary air cleaner elements.

#### **Storing Primary Air Cleaner Elements**

If a primary air cleaner element that passes inspection will not be used, the primary air cleaner element can be stored for future use.

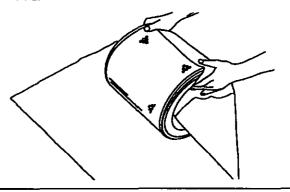


Illustration 39

q00281694

Do not use paint, a waterproof cover, or plastic as a protective covering for storage. Restricted air flow may result. To protect against dirt and damage, wrap the primary air cleaner elements in Volalite Corrosion Inhibited (VCI) paper.

Place the primary air cleaner element into a box for storage. For identification, mark the outside of the box and mark the primary air cleaner element. Include the following information:

- · Date of the cleaning
- Number of cleanings

Store the box in a dry location.

For more detailed information on cleaning the primary air cleaner element, refer to Special Publication, SEBF8062, "Procedure to Inspect and Clean Air Filters".

i01081178

# Engine Air Cleaner Element (Single Element) - Replace

SMCS Code: 1051; 1054-510

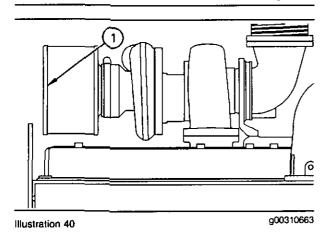
Perform the Operation and Maintenance Manual, "Engine Air Cleaner Service Indicator-Inspect" procedure and perform the Operation and Maintenance Manual, "Engine Air Precleaner - Clean" procedure (if equipped) before performing the following procedure.

#### NOTICE

Never run the engine without an air cleaner element installed. Never run the engine with a damaged air cleaner element. Do not use air cleaner elements with damaged pleats, gaskets or seals. Dirt entering the engine causes premature wear and damage to engine components. Air cleaner elements help to prevent airborne debris from entering the air inlet.

#### NOTICE

Never service the air cleaner element with the engine running since this will allow dirt to enter the engine.



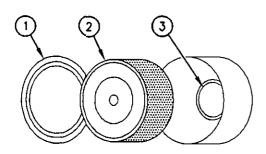


Illustration 41

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- Remove the air cleaner cover (1) and remove the element (2).
- Seal the turbocharger air inlet (3) so that debris cannot enter the air inlet. Tape or a clean cloth can be used to cover the opening.
- **3.** Clean the inside of the air cleaner cover. Clean the body that holds the air cleaner element.
- 4. Inspect the replacement element for the following items:damage, dirt, and debris.

- Remove the seal from the opening of the turbocharger inlet.
- 6. Install a clean, undamaged element.
- 7. Install the air cleaner cover (1).
- 8. Reset the service indicator.

i01175055

# **Engine Air Cleaner Service Indicator - Inspect**

SMCS Code: 7452-040

Some engines may be equipped with a different service indicator.

Some engines are equipped with a differential gauge for inlet air pressure. The differential gauge for inlet air pressure displays the difference in the pressure that is measured before the air cleaner element and the pressure that is measured after the air cleaner element. As the air cleaner element becomes dirty, the pressure differential rises. If your engine is equipped with a different type of service indicator, follow the OEM recommendations in order to service the air cleaner service indicator.

The service indicator may be mounted on the air cleaner element or in a remote location.

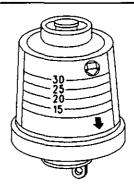


Illustration 42

g00103777

Typical service indicator

Observe the service indicator. The air cleaner element should be cleaned or the air cleaner element should be replaced when one of the following conditions occur:

- The yellow diaphragm enters the red zone.
- The red piston locks in the visible position.

#### **Test the Service Indicator**

Service indicators are important instruments.

- Check for ease of resetting. The service indicator should reset in less than three pushes.
- Check the movement of the yellow core when the engine is accelerated to the engine rated speed.
   The yellow core should latch approximately at the greatest vacuum that is attained.

If the service indicator does not reset easily, or if the yellow core does not latch at the greatest vacuum, the service indicator should be replaced. If the new service indicator will not reset, the hole for the service indicator may be plugged.

The service indicator may need to be replaced frequently in environments that are severely dusty, if necessary. Replace the service indicator annually regardless of the operating conditions. Replace the service indicator when the engine is overhauled, and whenever major engine components are replaced.

Note: When a new service indicator is installed, excessive force may crack the top of the service indicator. Tighten the service indicator to a torque of 2 N·m (18 lb in).

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# **Engine Air Precleaner - Clean**

SMCS Code: 1055-070

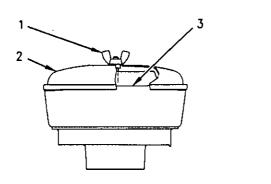


Illustration 43

g00736588

Typical precleaner

- (1) Wing nut
- (2) Cover
- (3) Body

Remove wing nut (1) and cover (2). Check for an accumulation of dirt and debris in body (3). Clean the body, if necessary.

After cleaning the precleaner, install cover (2) and wing nut (1).

Note: When the engine is operated in dusty applications, more frequent cleaning is required.

iongone 280

# Engine Crankcase Breather - Clean

SMCS Code: 1317-070

#### NOTICE

Perform this maintenance with the engine stopped.

If the crankcase breather is not maintained on a regular basis, the crankcase breather will become plugged. A plugged crankcase breather will cause excessive crankcase pressure that may cause crankshaft seal leakage.

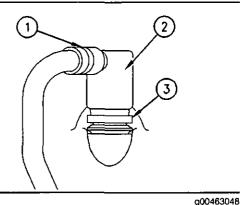


Illustration 44

Typical example

- (1) Hose clamp
- (2) Breather assembly
- (3) Retaining clamp
- 1. Loosen hose clamp (1) and remove the hose from breather assembly (2).
- Loosen the retaining clamp (3). Remove breather assembly (2) and the seal.
- Wash the breather element in solvent that is clean and nonflammable. Allow the breather element to dry before installation.
- 4. Install a breather element that is clean and dry. Install breather assembly and seal (2) and install clamp (3). Refer to the Operation and Maintenance Manual, "Torque Specifications" topic (Maintenance Section) for the proper torques.

5. Install the hose. Install hose clamp (1). Refer to the Operation and Maintenance Manual, "Torque Specifications" topic (Maintenance Section) for the proper torques.

i00687861

# **Engine Mounts - Inspect**

SMCS Code: 1152-040

Inspect the engine mounts for deterioration and for proper bolt torque. Engine vibration can be caused by the following conditions:

- Improper mounting of the engine
- · Deterioration of the engine mounts

Any engine mount that shows deterioration should be replaced. Refer to the Service Manual for the recommended torques. Refer to your Caterpillar dealer for more information.

i01402893

# **Engine Oil Level - Check**

SMCS Code: 1348-535-FLV

# WARNING

Hot oil and hot components can cause personal injury. Do not allow hot oil or hot components to contact the skin.

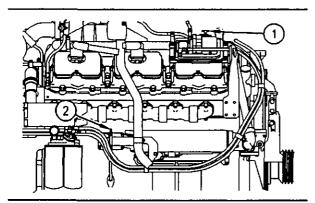


Illustration 45

(1) Oil filler cap

(2) Oil level gauge

000379132

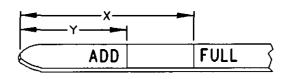


Illustration 46

g00110310

(Y) "ADD" mark (X) "FULL" mark

#### NOTICE

Perform this maintenance with the engine stopped.

Note: Before you perform this maintenance, do not operate the engine for at least 10 minutes in order to allow the engine oil to return to the oil pan.

1. Maintain the oil level between "ADD" mark (Y) and "FULL" mark (X) on oil level gauge (1). Do not fill the crankcase above "FULL" mark (X).

#### NOTICE

Operating your engine when the oil level is above the "FULL" mark could cause your crankshaft to dip into the oil. The air bubbles created from the crankshaft dipping into the oil reduces the oil's lubricating characteristics and could result in the loss of power.

2. Remove oil filler cap (2) and add oil, if necessary. Clean the oil filler cap. Reinstall the oil filler cap.

i01534451

# **Engine Oil Sample - Obtain**

SMCS Code: 1000-008; 1348-554-SM; 7542-554-OC, SM

In addition to a good preventive maintenance program, Caterpillar recommends using SOS oil analysis at regularly scheduled intervals in order to monitor the condition of the engine and the maintenance requirements of the engine.

# Obtain the Sample and the Analysis

#### **⚠** WARNING

Hot oil and hot components can cause personal injury. Do not allow hot oil or hot components to contact the skin.

Before you take the oil sample, complete the Label, PEEP5031 for identification of the sample. In order to help obtain the most accurate analysis, provide the following information:

- Engine model
- Service hours on the engine
- The number of hours that have accumulated since the last oil change
- The amount of oil that has been added since the last oil change

To ensure that the sample is representative of the oil in the crankcase, obtain a warm, well mixed oil sample.

To avoid contamination of the oil samples, the tools and the supplies that are used for obtaining oil samples must be clean.

Caterpillar recommends using the sampling valve in order to obtain oil samples. The quality and the consistency of the samples are better when the sampling valve is used. The location of the sampling valve allows oil that is flowing under pressure to be obtained during normal engine operation.

The 169-8373 Fluid Sampling Bottle is recommended for use with the sampling valve. The fluid sampling bottle includes the parts that are needed for obtaining oil samples. Instructions are also provided.

#### NOTICE

Do not use the same vacuum sampling pump for extracting oil samples that is used for extracting coolant samples.

A small residue of either type sample may remain in the pump and may cause a false positive analysis for the sample being taken.

Always use a designated pump for oil sampling and a designated pump for coolant sampling.

Failure to do so may cause a false analysis which could lead to customer and dealer concerns.

If the engine is not equipped with a sampling valve, use the 1U-5718 Vacuum Pump. The pump is designed to accept sampling bottles. Disposable tubing must be attached to the pump for insertion into the sump.

For instructions, see Special Publication, PEHP6001, "How To Take A Good Oil Sample". Consult your Caterpillar dealer for complete information and assistance in establishing an S·O·S program for your engine.

i01591548

# **Engine Oil and Filter - Change**

SMCS Code: 1318-510; 1348-044

## **WARNING**

Hot oil and hot components can cause personal injury. Do not allow hot oil or hot components to contact the skin.

Do not drain the oil when the engine is cold. As the oil cools, suspended waste particles settle on the bottom of the oil pan. The waste particles are not removed with the draining cold oil. Drain the crankcase with the engine stopped. Drain the crankcase with the oil warm. This draining method allows the waste particles that are suspended in the oil to be drained properly.

Failure to follow this recommended procedure will cause the waste particles to be recirculated through the engine lubrication system with the new oil.

# **Drain the Engine Oil**

After the engine has been run at the normal operating temperature, stop the engine. Use one of the following methods to drain the engine crankcase oil:

- If the engine is equipped with a drain valve, turn the drain valve knob counterclockwise in order to drain the oil. After the oil has drained, turn the drain valve knob clockwise in order to close the drain valve.
- If the engine is not equipped with a drain valve, remove the oil drain plug in order to allow the oil to drain. If the engine is equipped with a shallow sump, remove the bottom oil drain plugs from both ends of the oil pan.

After the oil has drained, the oil drain plugs should be cleaned and installed.

## Replace the Oil Filter

#### NOTICE

Caterpillar oil filters are built to Caterpillar specifications. Use of an oil filter not recommended by Caterpillar could result in severe engine damage to the engine bearings, crankshaft, etc., as a result of the larger waste particles from unfiltered oil entering the engine lubricating system. Only use oil filters recommended by Caterpillar.

- Remove the oil filter with a 1U-8760 Chain Wrench.
- 2. Cut the oil filter open with a 175-7546 Oil Filter Cutter Gp. Break apart the pleats and inspect the oil filter for metal debris. An excessive amount of metal debris in the oil filter may indicate early wear or a pending failure.

Use a magnet to differentiate between the ferrous metals and the nonferrous metals that are found in the oil filter element. Ferrous metals may indicate wear on the steel and cast iron parts of the engine.

Nonferrous metals may indicate wear on the aluminum parts, brass parts or bronze parts of the engine. Parts that may be affected include the following items: main bearings, rod bearings, turbocharger bearings, and cylinder heads.

Due to normal wear and friction, it is not uncommon to find small amounts of debris in the oil filter. Consult your Caterpillar dealer in order to arrange for a further analysis if an excessive amount of debris is found in the oil filter.

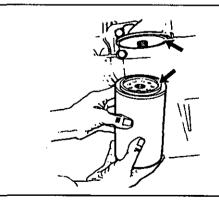


Illustration 47

g00103713

Typical filter mounting base and filter gasket

- Clean the sealing surface of the filter mounting base. Ensure that all of the old oil filter gasket is removed.
- 4. Apply clean engine oil to the new oil filter gasket.

#### NOTICE

Do not fill the oil filters with oil before installing them. This oil would not be filtered and could be contaminated. Contaminated oil can cause accelerated wear to engine components.

Install the oil filter. Tighten the oil filter until the oil filter gasket contacts the base. Tighten the oil filter by hand according to the instructions that are shown on the oil filter. Do not overtighten the oil filter.

## Fill the Engine Crankcase

 Remove the oil filler cap. Refer to the Operation and Maintenance Manual for more information on lubricant specifications. Fill the crankcase with the proper amount of oil. Refer to the Operation and Maintenance Manual for more information on refill capacities.

#### NOTICE

If equipped with an auxiliary oil filter system or a remote oil filter system, follow the OEM or filter manufacturer's recommendations. Under filling or overfilling the crankcase with oil can cause engine damage.

#### NOTICE

To prevent crankshaft bearing damage, crank the engine with the fuel OFF. This will fill the oil filters before starting the engine. Do not crank the engine for more than 30 seconds.

- Start the engine and run the engine at "LOW IDLE" for two minutes. Perform this procedure in order to ensure that the lubrication system has oil and that the oil filters are filled. Inspect the oil filter for oil leaks.
- 3. Stop the engine and allow the oil to drain back to the sump for a minimum of ten minutes.
- 4. Remove the oil level gauge in order to check the oil level. Maintain the oil level between the "ADD" and "FULL" marks on the oil level gauge.

i01061121

# Engine Speed/Timing Sensors - Check/Clean/Calibrate

SMCS Code: 1912-040; 1912-070; 1912-524

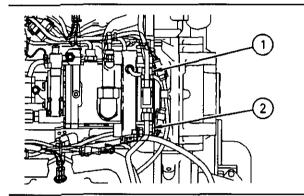


Illustration 48

g00372612

#### Top view

- (1) Secondary speed/timing sensor
- (2) Primary speed/timing sensor
- Remove the speed/timing sensors from the front housing. Check the condition of the plastic end of the speed/timing sensors for wear and/or contaminants.
- Clean the metal shavings and other debris from the face of the speed/timing sensors. Use the procedure in the Service Manual in order to calibrate the speed/timing sensors.

Refer to the Service Manual for more information on the speed/timing sensors.

i01430860

# Engine Storage Procedure - Check

SMCS Code: 1000-535

Caterpillar requires all engines that are stored for more than 3 months to follow storage procedures and start-up procedures. These procedures provide maximum protection to internal engine components. Refer to Special Instruction, SEHS9031, "Storage Procedure For Caterpillar Products" for information on these procedures.

An extension of the oil change interval to 12 months is permitted if you follow the required procedures for storage and start-up. This extension is permitted if the following intervals in the Operation and Maintenance Manual, "Maintenance Interval Schedule" have not been reached:

- Operating hours
- Fuel consumption

i00869628

# Engine Valve Lash - Inspect/Adjust

SMCS Code: 1102-025

The initial valve lash adjustment on new engines, rebuilt engines, or remanufactured engines is recommended at the first scheduled oil change. The adjustment is necessary due to the initial wear of the valve train components and to the seating of the valve train components.

This maintenance is recommended by Caterpillar as part of a lubrication and preventive maintenance schedule in order to help provide maximum engine life.

#### NOTICE

Only qualified service personnel should perform this maintenance. Refer to the Service Manual or your Caterpillar dealer for the complete valve lash adjustment procedure.

Operation of Caterpillar engines with improper valve adjustments can reduce engine efficiency. This reduced efficiency could result in excessive fuel usage and/or shortened engine component life.

## **MARNING**

Ensure that the engine can not be started while this maintenance is being performed. To help prevent possible injury, do not use the starting motor to turn the flywheel.

Hot engine components can cause burns. Allow additional time for the engine to cool before measuring/adjusting valve lash clearance.

Ensure that the engine is stopped before measuring the valve lash. To obtain an accurate measurement, allow the valves to cool before this maintenance is performed.

Refer to the Service Manual for more information.

01597115

# **Engine Valve Rotators - Inspect**

SMCS Code: 1109-040

#### **A WARNING**

When inspecting the valve rotators, protective glasses or face shield and protective clothing must be worn, to help prevent being burned by hot oil or spray.

Engine valve rotators rotate the valves when the engine runs. This helps to prevent deposits from building up on the valves and the valve seats.

Perform the following steps after the engine valve lash is set, but before the valve covers are installed:

- Start the engine according to Operation and Maintenance Manual, "Engine Starting" (Operation Section) for the procedure.
- 2. Operate the engine at low idle.
- Observe the top surface of each valve rotator. The valve rotators should turn slightly when the valves close.

#### NOTICE

A valve rotator which does not operate properly will accelerate valve face wear and valve seat wear and shorten valve life. If a damaged rotator is not replaced, valve face guttering could result and cause pieces of the valve to fall into the cylinder. This can cause piston and cylinder head damage.

If a valve fails to rotate, consult your Caterpillar dealer.

i00805059

# Ether Starting Aid Cylinder - Replace (If Equipped)

SMCS Code: 1456-510-CD

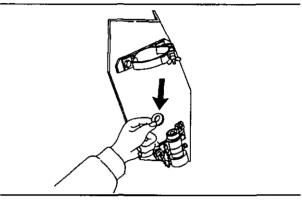


Illustration 49
Typical example

g00104888

- Loosen the ether cylinder clamp. Unscrew and remove the empty ether cylinder.
- 2. Remove the used gasket. Install the new gasket that is provided with each new ether cylinder.
- Install the new ether cylinder. Hand tighten the ether cylinder. Tighten the ether cylinder clamp securely.

i01423301

# Fan Drive Bearing - Lubricate

SMCS Code: 1359-086-BD

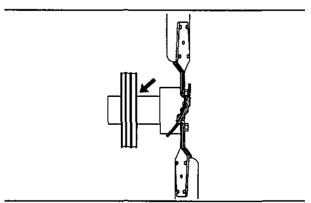


Illustration 50

q00746166

Typical location of the grease fitting that is for the fan drive bearing The pulley is shown with the belt guards removed Lubricate the grease fitting that is on the fan drive bearing with Bearing Lubricant or the equivalent.

Inspect the fan drive pulley assembly for wear or for damage. If the shaft is loose, an inspection of the internal components should be performed. Refer to the Service Manual for additional information.

i00823611

# **Fuel System - Prime**

SMCS Code: 1258-548

#### **▲ WARNING**

Fuel leaked or spilled onto hot surfaces or electrical components can cause a fire. To help prevent possible injury, turn the start switch off when changing fuel filters or water separator elements. Clean up fuel spills immediately.

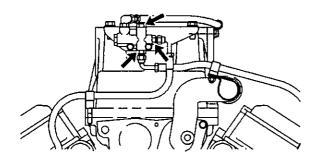


Illustration 51

g00395938

Fuel supply connections

The fuel system should be primed after a unit injector is changed or when the fuel system is totally dry.

Note: The fuel system does not typically need to be primed when the primary fuel filters or secondary fuel filters are changed or when an Electronic Control Module (ECM) is replaced. When the engine is started under these circumstances, the engine may momentarily run rough until the air is purged from the system.

#### NOTICE

Do not allow dirt to enter the fuel system. Thoroughly clean the area around a fuel system component that will be disconnected. Fit a suitable cover over any disconnected fuel system components.

 Loosen a fuel supply connection to the regulating valve, as shown. Note: The fuel priming pump is located on the primary filter/water separator. Operating the fuel priming pump without loosening a fuel connection upstream of the regulating valve can cause a failure of the fuel transfer pump seal.

- 2. Open the fuel priming pump and operate the pump until air is purged and the fuel appears at the fuel connection. Tighten the fuel connection.
- 3. Crank the engine after pressurizing the system.

#### NOTICE

Do not crank the engine continuously for more than 30 seconds. Allow the starting motor to cool for two minutes before cranking the engine again.

 If the engine does not start, repeat Steps 1 through 3 in order to start the engine.

01463757

# Fuel System Primary Filter/Water Separator - Drain

SMCS Code: 1260-543; 1263-543

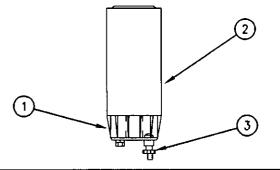


Illustration 52

g00668636

- (1) Bowl
- (2) Element
- (3) Drain

Bowl (1) should be monitored daily for signs of water. If water is present, drain the water from the bowl.

- Open drain (3). The drain is a self-ventilated drain. Catch the draining water in a suitable container. Dispose of the water properly.
- 2. Close drain (3).

#### NOTICE

The water separator is under suction during normal engine operation. Ensure that the drain valve is tightened securely to help prevent air from entering the fuel system.

i01254835

# Fuel System Primary Filter/Water Separator Element - Replace

SMCS Code: 1260-510-FQ; 1263-510-FQ

Water in the fuel can cause the engine to run rough. Water in the fuel may cause an electronic unit injector to fail. If the fuel has been contaminated with water, the element should be changed before the regularly scheduled interval.

The primary filter/water separator also provides filtration in order to help extend the life of the secondary fuel filter. The element should be changed regularly. If a vacuum gauge is installed, the primary filter/water separator should be changed if the pressure is at 50 to 70 kPa (15 to 20 inches Hg).

# Replace the Element

## **MARNING**

Fuel leaked or spilled onto hot surfaces or electrical components can cause a fire. To help prevent possible injury, turn the start switch off when changing fuel filters or water separator elements. Clean up fuel spills immediately.

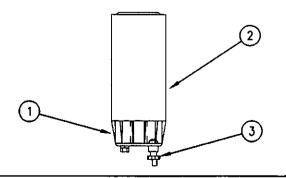


Illustration 53

g00668636

- (1) Bowl
- (2) Element
- (3) Drain

- 1. Stop the engine.
- 2. Turn the start switch to the "OFF" position.
- 3. Shut off the fuel tank supply valve to the engine.
- If the primary fuel filter is equipped with a drain valve (3), open the drain valve in order to drain any fuel from the filter case. Close the drain valve (3).

#### NOTICE

Use a suitable container to catch any fuel that might spill. Clean up any spilled fuel immediately.

- 5. Remove the fuel filter bowl (1) and wash the fuel filter bowl with clean diesel fuel.
- 6. Remove the fuel filter (2).
- Clean the gasket sealing surface of the fuel filter base. Ensure that all of the old gasket is removed.
- Apply clean diesel fuel to the new fuel filter gasket.

#### NOTICE

In order to maximize fuel system life and prevent premature wear out from abrasive particles in the fuel, use Caterpillar fuel filters.

Consult your Caterpillar dealer for proper part numbers.

9. Install the new fuel filter (2). Spin the fuel filter onto the fuel filter base until the gasket contacts the base. Use the rotation index marks on the filters as a guide for proper tightening. Tighten the filter for an additional 3/4 turn by hand. Do not overtighten the filter.

#### NOTICE

Do not fill the fuel filters with fuel before installing them. The fuel would not be filtered and could be contaminated. Contaminated fuel will cause accelerated wear to fuel system parts.

Install the clean fuel filter bowl (1) on the new fuel filter.

#### NOTICE

The water separator is under suction during normal engine operation. Ensure that the vent plug is tightened securely to help prevent air from entering the fuel system.

11. Open the fuel tank supply valve.

12. Start the engine and check for leaks. Run the engine for one minute. Stop the engine and check the engine for leaks again.

Leaks are difficult to detect while the engine is running. The primary filter/water separator is under suction. A leak will allow air to enter the fuel. The air in the fuel can cause low power due to aeration of the fuel. If air enters the fuel, check the components for overtightening or undertightening.

00823807

# Fuel System Secondary Filter - Replace

SMCS Code: 1261-510-SE

# **A WARNING**

Fuel leaked or spilled onto hot surfaces or electrical components can cause a fire. To help prevent possible injury, turn the start switch off when changing fuel filters or water separator elements. Clean up fuel spills immediately.

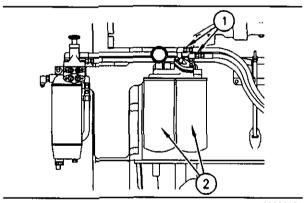


Illustration 54

g00396257

- (1) Fuel supply connections
- (2) Fuel filters

#### NOTICE

Do not allow dirt to enter the fuel system. Thoroughly clean the area around a fuel system component that will be disconnected. Fit a suitable cover over any disconnected fuel system components.

#### NOTICE

Use a suitable container to catch any fuel that might spill. Clean up any spilled fuel immediately.

 It may be necessary to relieve residual fuel pressure from the fuel system before removing the fuel filter. Loosen one of the fuel supply connections (1) in order to purge any residual pressure.

#### NOTICE

Do not loosen fuel lines or fittings at the fuel manifold or ECM. The engine components may be damaged.

- 2. Remove the used fuel filter.
- Clean the gasket sealing surface of the fuel filter base. Ensure that all of the old gasket is removed.
- Apply clean diesel fuel to the new fuel filter gasket.

#### NOTICE

Do not fill the secondary fuel filter with fuel before installing. The fuel would not be filtered and could be contaminated. Contaminated fuel will cause accelerated wear to fuel system parts.

5. Install the new fuel filter. Spin the fuel filter onto the fuel filter base until the gasket contacts the base. Use the rotation index marks on the filters as a guide for proper tightening. Tighten the filter for an additional 3/4 turn by hand. Do not overtighten the filter.

i00073301

# Fuel Tank Water and Sediment - Drain

SMCS Code: 1273-543-M&S

#### **Fuel Tank**

Fuel quality is critical to the performance and to the service life of the engine. Water in the fuel can cause excessive fuel system wear. Condensation occurs during the heating and cooling of fuel. The condensation occurs as the fuel passes through the fuel system and the fuel returns to the fuel tank. This causes water to accumulate in fuel tanks. Draining the fuel tank regularly and obtaining fuel from reliable sources can help to eliminate water in the fuel.

### **Drain the Water and the Sediment**

Fuel tanks should contain some provision for draining water and draining sediment from the bottom of the fuel tanks.

Open the drain valve on the bottom of the fuel tank in order to drain the water and the sediment. Close the drain valve. Check the fuel daily. Drain the water and sediment from the fuel tank after operating the engine or drain the water and sediment from the fuel tank after the fuel tank has been filled. Allow five to ten minutes before performing this procedure.

Fill the fuel tank after operating the engine in order to drive out moist air. This will help prevent condensation. Do not fill the tank to the top. The fuel expands as the fuel gets warm. The tank may overflow.

Some fuel tanks use supply pipes that allow water and sediment to settle below the end of the fuel supply pipe. Some fuel tanks use supply lines that take fuel directly from the bottom of the tank. If the engine is equipped with this system, regular maintenance of the fuel system filter is important.

### **Fuel Storage Tanks**

Drain the water and the sediment from the fuel storage tank during the following conditions:

- Weekly
- Oil change
- · Refill of the tank

This will help prevent water or sediment from being pumped from the storage tank into the engine fuel tank.

If a bulk storage tank has been refilled or moved recently, allow adequate time for the sediment to settle before filling the engine fuel tank. Internal baffles in the bulk storage tank will also help trap sediment. Filtering fuel that is pumped from the storage tank helps to ensure the quality of the fuel. When possible, water separators should be used.

i00907072

# Hoses and Clamps - Inspect/Replace

SMCS Code: 7554-040; 7554-510

Inspect all hoses for leaks that are caused by the following conditions:

- Cracking
- Softness
- Loose clamps

Replace hoses that are cracked or soft. Tighten any loose clamps.

#### NOTICE

Do not bend or strike high pressure lines. Do not install bent or damaged lines, tubes or hoses. Repair any loose or damaged fuel and oil lines, tubes and hoses. Leaks can cause fires. Inspect all lines, tubes and hoses carefully. Tighten all connections to the recommended torque.

Check for the following conditions:

- End fittings that are damaged or leaking
- Outer covering that is chafed or cut
- Exposed wire that is used for reinforcement
- Outer covering that is ballooning locally
- Flexible part of the hose that is kinked or crushed
- Armoring that is embedded in the outer covering

A constant torque hose clamp can be used in place of any standard hose clamp. Ensure that the constant torque hose clamp is the same size as the standard clamp.

Due to extreme temperature changes, the hose will heat set. Heat setting causes hose clamps to loosen. This can result in leaks. A constant torque hose clamp will help to prevent loose hose clamps.

Each installation application can be different. The differences depend on the following factors:

- Type of hose
- Type of fitting material
- Anticipated expansion and contraction of the hose
- Anticipated expansion and contraction of the fittings

# Replace the Hoses and the Clamps

## **MARNING**

Pressurized System: Hot coolant can cause serious burns. To open the cooling system filler cap, stop the engine and wait until the cooling system components are cool. Loosen the cooling system pressure cap slowly in order to relieve the pressure.

1. Stop the engine. Allow the engine to cool.

Loosen the cooling system filler cap slowly in order to relieve any pressure. Remove the cooling system filler cap.

Note: Drain the coolant into a suitable, clean container. The coolant can be reused.

- Drain the coolant from the cooling system to a level that is below the hose that is being replaced.
- 4. Remove the hose clamps.
- Disconnect the old hose.
- 6. Replace the old hose with a new hose.

Note: For torques on hose clamps, see this Operation and Maintenance Manual, "Torque Specifications" (Maintenance Section).

Install the hose clamps with a torque wrench.

Note: For the proper coolant to use, see this Operation and Maintenance Manual, "Coolant Recommendations" (Maintenance Section).

- 8. Refill the cooling system.
- Clean the cooling system filler cap. Inspect the cooling system filler cap's gaskets. Replace the cooling system filler cap if the gaskets are damaged. Install the cooling system filler cap.
- Start the engine. Inspect the cooling system for leaks.

i01136294

# **Overhaul Considerations**

SMCS Code: 7595-043

Reduced hours of operation at full load will result in a lower average power demand. A decreased average power demand should increase both the engine service life and the overhaul interval.

The need for an overhaul is generally indicated by increased fuel consumption and by reduced power.

The following factors are important when a decision is being made on the proper time for an engine overhaul:

- The need for preventive maintenance
- The quality of the fuel that is being used
- The operating conditions

• The results of the S·O·S analysis

# Oil Consumption as an Overhaul Indicator

Oil consumption, fuel consumption, and maintenance information can be used to estimate the total operating cost for your Caterpillar engine. Oil consumption can also be used to estimate the required capacity of a makeup oil tank that is suitable for the maintenance intervals.

Oil consumption is in proportion to the percentage of the rated engine load. As the percentage of the engine load is increased, the amount of oil that is consumed per hour also increases.

The oil consumption rate (brake specific oil consumption) is measured in grams per kW/h (lb per bhp). The brake specific oil consumption (BSOC) depends on the engine load. Consult your Caterpillar dealer for assistance in determining the typical oil consumption rate for your engine.

When an engine's oil consumption has risen to three times the original oil consumption rate due to normal wear, an engine overhaul should be scheduled. There may be a corresponding increase in blowby and a slight increase in fuel consumption.

#### Overhaul Options

#### Before Failure Overhaul

A planned overhaul before failure may be the best value for the following reasons:

- Costly unplanned downtime can be avoided.
- Many original parts can be reused according to the standards for reusable parts.
- The engine service life can be extended without the risk of a major catastrophe due to engine failure.
- The best cost/value relationship per hour of extended life can be attained.

#### After Failure Overhaul

If a major engine failure occurs and the engine must be removed, many options are available. An overhaul should be performed if the engine block or the crankshaft needs to be repaired.

If the engine block is repairable and/or the crankshaft is repairable, the overhaul cost should be between 40 percent and 50 percent of the cost of a new engine with a similar exchange core.

This lower cost can be attributed to three aspects:

- Specially designed Caterpillar engine features
- Caterpillar dealer exchange components
- Caterpillar Inc. remanufactured exchange components

#### Overhaul Recommendation

To minimize downtime, a scheduled engine overhaul by your Caterpillar dealer is recommended. This will provide you with the best cost/value relationship.

Note: Overhaul programs vary according to the engine application and according to the dealer that performs the overhaul. Consult your Caterpillar dealer for specific information about the available overhaul programs and about overhaul services for extending the engine life.

If an overhaul is performed without overhaul service from your Caterpillar dealer, be aware of the following maintenance recommendations.

#### **Unit Fuel Injector**

Clean the fuel injector body and replace the O-rings. Replace the O-rings and the gasket on the injector sleeve. Clean the area around the injector seating in the injector sleeve. Refer to the Service Manual for the complete procedure, or consult with your Caterpillar dealer for assistance.

#### Rebuild or Exchange

Cylinder Head Assembly, Connecting Rods, Pistons, Cylinder Liners, Turbocharger, Cylinder Packs, Oil Pump, and Fuel Transfer Pump

These components should be inspected according to the instructions that are found in various Caterpillar reusability publications. The Special Publication, SEBF8029 lists the reusability publications that are needed for inspecting the engine parts.

If the parts comply with the established inspection specifications that are expressed in the reusable parts guideline, the parts should be reused.

Parts that are not within the established inspection specifications should be dealt with in one of the following manners:

- Salvaging
- Repairing

Replacing

Using out-of-spec parts can result in the following problems:

- Unscheduled downtime
- Costly repairs
- Damage to other engine parts
- Reduced engine efficiency
- Increased fuel consumption

Reduced engine efficiency and increased fuel consumption translates into higher operating costs. Therefore, Caterpillar Inc. recommends repairing out-of-spec parts or replacing out-of-spec parts.

#### Inspection and/or Replacement

# Piston Rings, Crankshaft Bearings, Valve Rotators, and Crankshaft Seals

The following components may not last until the second overhaul.

- Thrust bearings
- Main bearings
- Rod bearings
- Valve rotators
- · Crankshaft seals

Caterpillar Inc. recommends the installation of new parts at each overhaul period.

Inspect these parts while the engine is disassembled for an overhaul.

Inspect the crankshaft for any of the following conditions:

- Deflection
- Damage to the journals
- Bearing material that has seized to the journals

Check the journal taper and the profile of the crankshaft journals. Check these components by interpreting the wear patterns on the following components:

- Rod bearing
- Main bearings

Note: If the crankshaft is removed for any reason, use the magnetic particle inspection process to check for cracks in the crankshaft.

Inspect the camshaft for damage to the journals and to the lobes.

Note: If the camshaft is removed for any reason, use the magnetic particle inspection process to check for cracks in the camshaft.

Inspect the following components for signs of wear or for signs of scuffing:

- Camshaft bearings
- Camshaft followers

Caterpillar Inc. recommends replacing the crankshaft vibration damper.

#### Oil Cooler Core and Aftercooler Core

During an overhaul, the removal of the oil cooler core and the aftercooler core is recommended. The oil cooler core and the aftercooler core should be cleaned and pressure tested.

#### NOTICE

Do not use caustic cleaners to clean the core.

Caustic cleaners can attack the internal metals of the core and cause leakage.

Note: Use this cleaning procedure to clean the oil cooler core and the aftercooler core.

- Remove the oil cooler core and the aftercooler core.
- 2. Remove any debris from the oil cooler core and the aftercooler core. To remove debris from the oil cooler core, turn the oil cooler core onto one end. To remove debris from the aftercooler core, turn the aftercooler core upside-down.
- Flush the oil cooler core and the aftercooler core internally with cleaner in order to loosen foreign substances. This will also help to remove oil from the oil cooler core and the aftercooler core.

Note: The use of Hydrosolv Liquid Cleaners is recommended. Table 39 lists the Hydrosolv Liquid Cleaners that are available from your Caterpillar dealer.

Table 39

HydrosolvLiquid Cleaners		
Part Number	Description	Size
1U-8812	Hydrosolv4165	4 L (1 US gallon)
1U-5490	]	19 L (5 US gallon)
8T-7570		208 L (55 US gallon)
1U-8804	Hydrosolv100	4 L (1 US gallon)
1U-5492	]	19 L (5 US gallon)
8T-5571	]	208 L (55 US gallon)

- 4. Use steam to clean the oil cooler core and the aftercooler core. This removes any remaining residue from the cleaner. Flush the fins of the oil cooler core and the aftercooler core. Remove any other trapped debris.
- Wash the oil cooler core and the aftercooler core with hot, soapy water. Rinse the oil cooler core and the aftercooler core thoroughly with clean water.

#### **A WARNING**

Personal injury can result from air pressure.

Personal injury can result without following proper procedure. When using pressure air, wear a protective face shield and protective clothing.

Maximum air pressure at the nozzle must be less than 205 kPa (30 psi) for cleaning purposes.

- Dry the oil cooler core and the aftercooler core with compressed air. Direct the air in the reverse direction of the normal flow.
- 7. Inspect the components in order to ensure cleanliness. The oil cooler core and the aftercooler core should be pressure tested. Repair the oil cooler core and the aftercooler core, if necessary. Install the oil cooler core and the aftercooler core.

For more information about cleaning the cores, consult your Caterpillar dealer.

#### **Obtain Coolant Analysis**

The concentration of supplemental coolant additive (SCA) should be checked regularly with test kits or with S-O-S Coolant Analysis (Level 1). Further coolant analysis is recommended when the engine is overhauled.

A coolant analysis can be conducted in order to verify the condition of the water that is being used in the cooling system. A full water analysis can be obtained by consulting your local water utility company or an agricultural agent. Private laboratories are also available for water analysis.

Caterpillar Inc. recommends an S-O-S Coolant Analysis (Level 2).

#### S-O-S Coolant Analysis (Level 2)

An S·O·S Coolant Analysis (Level 2) is a comprehensive coolant analysis which completely analyzes the coolant and the effects on the cooling system. An S.O.S Coolant Analysis (Level 2) provides the following information:

- Complete S·O·S Coolant Analysis (Level 2)
- Visual inspection of properties
- Identification of metal corrosion
- Identification of contaminants
- Identification of built up impurities (corrosion and scale)

S·O·S Coolant Analysis (Level 2) provides a report of the results of both the analysis and the maintenance recommendations.

For more information about coolant analysis, consult vour Caterpillar dealer.

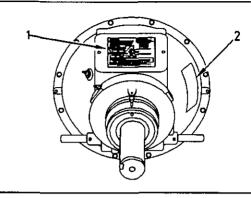
i01506009

# Power Take-Off Clutch -Check/Adjust/Lubricate

SMCS Code: 3055-036: 3055-086

#### NOTICE

New power take-offs should have the clutch adjustment checked before being placed into service. The clutch adjustment should be checked again after the first ten hours of operation. New clutch plates have a "wear in" period, and the clutch may require several adjustments until the new plates are "worn in".



g00781502

Illustration 55

- (1) Instruction plate
- (2) Serial number plate

Check the clutch adjustment regularly after "wear in". Heavy-duty applications which have engagements that are frequent and relatively long periods of clutch slippage require more frequent adjustment than light-duty applications. The operating torque should be measured in order to determine if a clutch adjustment is required.

Refer to the OEM information and instruction plate (1) for instructions on lubrication, adjustment, and other recommendations for service. Perform the maintenance that is specified on the instruction plate.

#### **⚠** WARNING

Do not operate the engine with the Instruction Plate cover removed from the clutch. Personal injury may result.

If the clutch is damaged to the point of burst failure, expelled pieces can cause personal injury to anyone in the immediate area. Proper safeguards must be followed to help prevent accidents.

i01604510

# Radiator - Clean

SMCS Code: 1353-070

Note: Adjust the frequency of cleaning according to the effects of the operating environment.

Inspect the radiator for these items: damaged fins, corrosion, dirt, grease, insects, leaves, oil, and other debris. Clean the radiator, if necessary.

#### **WARNING**

Personal injury can result from air pressure.

Personal injury can result without following proper procedure. When using pressure air, wear a protective face shield and protective clothing.

Maximum air pressure at the nozzle must be less than 205 kPa (30 psi) for cleaning purposes.

Pressurized air is the preferred method for removing loose debris. Direct the air in the opposite direction of the fan's air flow. Hold the nozzle approximately 6 mm (0.25 inch) away from the fins. Slowly move the air nozzle in a direction that is parallel with the tubes. This will remove debris that is between the tubes.

Pressurized water may also be used for cleaning. The maximum water pressure for cleaning purposes must be less than 275 kPa (40 psi). Use pressurized water in order to soften mud. Clean the core from both sides.

Use a degreaser and steam for removal of oil and grease. Clean both sides of the core. Wash the core with detergent and hot water. Thoroughly rinse the core with clean water.

After cleaning, start the engine and accelerate the engine to high idle rpm. This will help in the removal of debris and drying of the core. Stop the engine. Use a light bulb behind the core in order to inspect the core for cleanliness. Repeat the cleaning, if necessary.

Inspect the fins for damage. Bent fins may be opened with a "comb". Inspect these items for good condition: welds, mounting brackets, air lines, connections, clamps, and seals. Make repairs, if necessary.

For more detailed information on cleaning and inspection, refer to Special Publication, SEBD0518, "Know Your Cooling System".

i00151038

# Severe Service Application - Check

SMCS Code: 1000-535

Severe service is an application of an engine that exceeds current published standards for that engine. Caterpillar maintains standards for the following engine parameters:

- Performance (power range, speed range, and fuel consumption)
- Fuel quality
- Altitude range
- Maintenance intervals
- Oil selection and maintenance
- Coolant selection and maintenance
- Environmental qualities
- Installation

Refer to the standards for the engine or consult with your Caterpillar dealer in order to determine if the engine is operating within the defined parameters.

Severe service operation can accelerate component wear. Engines that operate under severe conditions may need more frequent maintenance intervals in order to ensure maximum reliability and retention of full service life.

Due to individual applications, it is not possible to identify all of the factors which can contribute to severe service operation. Consult your Caterpillar dealer for the unique maintenance that is necessary for the engine.

The operating environment, improper operating procedures and improper maintenance procedures can be factors which contribute to severe service conditions.

#### **Environmental Factors**

Ambient temperatures – The engine may be exposed to extended operation in extremely cold environments or hot environments. Valve components can be damaged by carbon buildup if the engine is frequently started and stopped in very cold temperatures. Extremely hot inlet air reduces engine performance.

Air Quality – The engine may be exposed to extended operation in an environment that is dirty or dusty, unless the equipment is cleaned regularly. Mud, dirt and dust can encase components. Maintenance can be very difficult. The buildup can contain corrosive chemicals.

Buildup – Compounds, elements, corrosive chemicals and salt can damage some components.

Altitude – Problems can arise when the engine is operated at altitudes that are higher than the intended settings for that application. Necessary adjustments should be made.

## **Improper Operating Procedures**

- · Extended operation at low idle
- Frequent hot shutdowns
- · Operating at excessive loads
- Operating at excessive speeds
- Operating outside the intended application

## Improper Maintenance Procedures

- · Extending the maintenance intervals
- Failure to use recommended fuel, lubricants and coolant/antifreeze

i00651416

# **Starting Motor - Inspect**

SMCS Code: 1451-040; 1453-040

Caterpillar Inc. recommends a scheduled inspection of the starting motor. If the starting motor fails, the engine may not start in an emergency situation.

Check the starting motor for proper operation. Check the electrical connections and clean the electrical connections. Refer to the Service Manual for more information on the checking procedure and for specifications or consult your Caterpillar dealer for assistance.

i01539769

# **Turbocharger - Inspect**

SMCS Code: 1052-040

Periodic inspection and cleaning is recommended for the turbocharger compressor housing (inlet side). Any fumes from the crankcase are filtered through the air inlet system. Therefore, by-products from oil and from combustion can collect in the turbocharger compressor housing. Over time, this buildup can contribute to loss of engine power, increased black smoke and overall loss of engine efficiency.

If the turbocharger fails during engine operation, damage to the turbocharger compressor wheel and/or to the engine may occur. Damage to the turbocharger compressor wheel can cause additional damage to the pistons, the valves, and the cylinder head.

#### NOTICE

Turbocharger bearing failures can cause large quantities of oil to enter the air inlet and exhaust systems. Loss of engine lubricant can result in serious engine damage.

Minor leakage of a turbocharger housing under extended low idle operation should not cause problems as long as a turbocharger bearing failure has not occurred.

When a turbocharger bearing failure is accompanied by a significant engine performance loss (exhaust smoke or engine rpm up at no load), do not continue engine operation until the turbocharger is repaired or replaced.

An inspection of the turbocharger can minimize unscheduled downtime. An inspection of the turbocharger can also reduce the chance for potential damage to other engine parts.

Note: Turbocharger components require precision clearances. The turbocharger cartridge must be balanced due to high rpm. Severe Service Applications can accelerate component wear. Severe Service Applications require more frequent inspections of the cartridge.

#### Removal and Installation

For options regarding the removal, installation, repair and replacement, consult your Caterpillar dealer. Refer to the Service Manual for this engine for the procedure and specifications.

# **Cleaning and Inspecting**

 Remove the exhaust outlet piping and remove the air inlet piping from the turbocharger. Visually inspect the piping for the presence of oil. Clean the interior of the pipes in order to prevent dirt from entering during reassembly.

- 2. Turn the compressor wheel and the turbine wheel by hand. The assembly should turn freely. Inspect the compressor wheel and the turbine wheel for contact with the turbocharger housing. There should not be any visible signs of contact between the turbine wheel or compressor wheel and the turbocharger housing. If there is any indication of contact between the rotating turbine wheel or the compressor wheel and the turbocharger housing, the turbocharger must be reconditioned.
- Check the compressor wheel for cleanliness.
   If only the blade side of the wheel is dirty,
   dirt and/or moisture is passing through the air
   filtering system. If oil is found only on the back
   side of the wheel, there is a possibility of a failed
   turbocharger oil seal.

The presence of oil may be the result of extended engine operation at low idle. The presence of oil may also be the result of a restriction of the line for the inlet air (plugged air filters), which causes the turbocharger to slobber.

- 4. Use a dial indicator to check the end clearance on the shaft. If the measured end play is greater than the Service Manual specifications, the turbocharger should be repaired or replaced. An end play measurement that is less than the minimum Service Manual specifications could indicate carbon buildup on the turbine wheel. The turbocharger should be disassembled for cleaning and for inspection if the measured end play is less than the minimum Service Manual specifications.
- Inspect the bore of the turbine housing for corrosion.
- **6.** Clean the turbocharger housing with standard shop solvents and a soft bristle brush.
- Fasten the air inlet piping and the exhaust outlet piping to the turbocharger housing.

i01083059

# **Walk-Around Inspection**

SMCS Code: 1000-040

# Inspect the Engine for Leaks and for Loose Connections

A walk-around inspection should only take a few minutes. When the time is taken to perform these checks, costly repairs and accidents can be avoided.

For maximum engine service life, make a thorough inspection of the engine compartment before starting the engine. Look for items such as oil leaks or coolant leaks, loose bolts, worn belts, loose connections and trash buildup. Make repairs, as needed:

- The guards must be in the proper place. Repair damaged guards or replace missing guards.
- Wipe all caps and plugs before the engine is serviced in order to reduce the chance of system contamination.

#### NOTICE

For any type of leak (coolant, lube, or fuel) clean up the fluid. If leaking is observed, find the source and correct the leak. If leaking is suspected, check the fluid levels more often than recommended until the leak is found or fixed, or until the suspicion of a leak is proved to be unwarranted.

#### NOTICE

Accumulated grease and/or oil on an engine or deck is a fire hazard. Remove this debris with steam cleaning or high pressure water.

- Ensure that the cooling lines are properly clamped. Make sure that the clamps are tight.
   Check for leaks. Check the condition of all pipes.
- Inspect the water pumps for coolant leaks.

Note: The water pump seal is lubricated by coolant in the cooling system. It is normal for a small amount of leakage to occur as the engine cools down and the parts contract.

Excessive coolant leakage may indicate the need to replace the water pump seal. For the removal of water pumps and the installation of water pumps and/or seals, refer to the Service Manual for the engine or consult your Caterpillar dealer.

- Inspect the lubrication system for leaks at the front crankshaft seal, the rear crankshaft seal, the oil pan, the oil filters and the valve cover.
- Inspect the fuel system for leaks. Inspect the hose from the high pressure oil pump to the left side of the fluid manifold.
- Inspect the piping for the air inlet system and the elbows for cracks and for loose clamps.
- Inspect the alternator belt and the accessory drive belts for cracks, breaks or other damage.

Belts for multiple groove pulleys must be replaced as matched sets. If only one belt is replaced, the belt will carry more load than the belts that are not replaced. The older belts are stretched. The additional load on the new belt could cause the belt to break.

- Drain the water and the sediment from fuel tanks on a daily basis in order to ensure that only clean fuel enters the fuel system.
- Inspect the wiring and the wiring harnesses for loose connections and for worn wires or frayed wires.
- Inspect the ground strap for a good connection and for good condition.
- Inspect the ECM to the cylinder head ground strap for a good connection and for good condition.
- Disconnect any battery chargers that are not protected against the current drain of the starting motor. Check the condition and the electrolyte level of the batteries, unless the engine is equipped with a maintenance free battery.
- Check the condition of the gauges. Replace any of the gauges which are cracked. Replace any of the gauges which can not be calibrated.

i01057943

# Water Pump - Inspect

SMCS Code: 1361-040; 1361

A failed water pump might cause severe engine overheating problems that could result in the following conditions:

- · Cracks in the cylinder head
- A piston seizure
- Other potential damage to the engine

Visually inspect the water pump for leaks. If any leaking is observed, replace the water pump seal or the water pump assembly. Refer to the Service Manual for the disassembly and assembly procedure.

Note: Refer to the Service Manual or consult your Caterpillar dealer if any repair is needed or any replacement is needed.

#### MPU-IR-WMA-108 Ref: WMA Testimonv-2. p.6.1.1-7

- Provide all documents supporting the statement that the backwash water was conveyed to the Golf Course.
- Provide all calculations or estimates of the amount of backwash water provided.
- c. Provide all calculations or estimates of the value of any backwash water actually provided.

#### RESPONSE:

- a. Disposition and use of the backwash water from the Puuokoli treatment facilities are described in MPU's response to CA-IR-46a in PUC Docket No. 2002-0371. Pipelines that conveyed the backwash water from the Puuokoli treatment facilities to the golf course are shown on a map contained in MPU's attachment CA-IR-3c for the aforementioned proceedings.
- b. The amount of backwash water generated at the Puuokoli treatment facilities was stated as approximately 100,000 gallons per day in MPU's response to CA-IR-46c for PUC Docket No. 2002-0371.
- c. As stated in MPU's responses to CA-IR-46a and CA-SIR-12 in Docket No. 2002-0371, irrigation water for the golf course was obtained from the following sources in order of priority.
  - Wastewater effluent from MOSCO, Inc.
  - Backwash water from Puuokoli
  - Potable water from MPU

Thus, the value of backwash water used for golf course irrigation purposes was the same as the value of potable water which would have been purchased from MPU. The published tariff rate for monthly water consumption was \$1.94 per thousand gallons prior to the proceedings and \$3.18 per thousand gallons subsequent thereto.

SPONSOR:

Robert Marusich

MPU-IR-WMA-109 Ref: WMA Testimonv-2, p.6.1, 21-23

Explain why billing information for the water loss calculations were not taken from the data provided in responses IRs and SIRs in this proceeding.

RESPONSE:

Information provided in MPU's responses to IR's and SIR's has, in fact, been used in all of the water loss calculations submitted by WMA. Meter readings for the Mahana Pump Station were taken directly from MPU's Attachment CA-IR-37a. All other meter readings were taken from the Molokai Properties Intercompany Water Sales Reports first obtained from the public record for HPUC Docket No. 2008-0115, and later furnished for a much longer time interval in MPU's Attachment WMA-SIR-105k. Inasmuch as the Intercompany Water Sales Reports contain actual meter readings on specified billing dates and are the primary records for audit purposes, they were deemed to be of superior quality and, therefore, were used in the calculations wherever possible. Furthermore, the use of actual meter readings at the beginning and the end of the interval under consideration simplifies the calculations and minimizes the probability of arithmetic errors.

SPONSOR:

Robert Marusich

#### MPU-IR-WMA-110 Ref: WMA Testimonv-2. p.8.1.10-11

Provide the inventory levels used in the calculations:

- a. For the two reservoirs mentioned in testimony.
- b. For the water stored at the MIS.
- c. Is WMA aware that the DOH has approved the storage of MPU water in the MIS in the event of a breakdown in Well
   17?
  - If no water storage at the MIS was used, please explain why the changes in the water stored in the MIS was not measured in the WMA calculations.

#### RESPONSE:

- a. Inventory levels for these two reservoirs were not provided by MPU in response to WMA-SIR-105.I and, therefore, were not readily available for inclusion in WMA's direct testimonies. Furthermore, as noted in the next paragraph, (lines 12 through 15) "... inventory gains/losses will have little effect on calculations based upon 12 months of data".
- b. Inventory levels in the MIS are not relevant to the calculations in Exhibit WMA-202. This exhibit only addresses water losses in a portion of the system beyond (or downstream) of the MIS. More specifically, from the two metered sources of untreated surface water (Mahana Pump Station and Mountain Water System) to the two metered outputs of finished (i.e., potable) water.
- c. No. WMA is not aware of any such approvals. The salient question is whether the DOA or the prior managing agents of the MIS have approved such water storage. No explicit provisions for

water storage are contained in the MIS agreements submitted in response to CA-IR-6.

c-1. See response to b., above.

**SPONSOR:** Robert Marusich

## MPU-IR-WMA-111 Ref: WMA Testimonv-2. p. 17.1.1-3

Provide an update to the testimony and calculations referred to which would use the responses to WMA's SIRs.

- a. Provide any support that shows Well 17 water is or has been provided to WOM over an extended period of time.
- b. Provide any support that WMA has that MPU intends to provide water to WOM from Well 17 over any extended period of time.

**RESPONSE:** No update required. See response to MPU-IR-WMA-109.

a. Detailed calculations of excess water production from Well #17 during MPU fiscal years 2007 and 2008, and subsequent use thereof by WOM, are presented in Attachment MPU-IR-WMA-111a. As indicated therein, untreated water from the Mahana Pump Station exceeded calculated requirements by approximately 10,923 TG in FY 2007, and 43,748 TG in FY 2008. These amounts correspond to approximately 24.5% of WOM's untreated water requirement from MPL"s Mountain Water System during FY 2007, and approximately 70.9% of WOM's untreated water requirement from MPL's Mountain Water System during FY 2008.

Mahana Pump Station meter readings prior to January 2006 and the date of commissioning for the Puunana Water Treatment

Plant are required to develop similar calculations for FY 2006

b. WMA will not speculate on MPU's future intentions. We do know that inappropriate transfers took place during Fiscal Years 2007 and 2008, but have not received any information from MPU regarding corrective measures to prevent similar occurrences. See WMA Testimony-2, page18, lines11-22.

SPONSOR: Robert Marusich

# ATTACHMENT A TO WMA'S RESPONSE TO MPU-IR-WMA-111(a)

(8 PAGES)

Water Loss Calculations for Puunana/Maunaloa Water Storage & Treatment Facilities July 2006 through June 2007 (MPU Fiscal Year 2007)

Inputs Mahana Ruma		
Mahana Pump 06/30/2007 Meter Reading	536,121	
07/01/2006 Meter Reading	( <u>219,729)</u>	316,392.0
		010,002.0
Mountain Water System 06/26/2007 Meter Reading	61,367,000	
06/23/2006 Meter Reading	(27,629,000)	
		33,738.0
Total Metered In		350,130.0
Outputs		
Kaluakoi Project Meter 06/26/2007 Meter Reading	594 167 400	
06/23/2006 Meter Reading	584,167,400 ( <u>354,922,400)</u>	
·	<del></del> -	229,245.0
Moana Makani Meter		
06/26/2007 Meter Reading	63,825,200	
06/23/2006 Meter Reading	( 50,052,400)	13,772.8
M (M(OM) M 1		75,11215
Maunaloa (WOM) Meter 06/26/2007 Meter Reading	813,852,000	
06/23/2006 Meter Reading	<u>( 767,875,000)</u>	
Less Moana Makani	45,977,000 (43,773,800)	
Less Moana Makani	<u>( 13,772,800)</u>	32,204.2
Manayainyi (MOM) Matar		
Manawainui (WOM) Meter 06/26/2007 Meter Reading	9,757,700	
06/23/2006 Meter Reading	(6,431,200)	
		<u>3,326.5</u>
Total Metered Out		278,548.5

**Inventory Gains** 

Puunana Raw Water Reservoir 06/26/2007 Measurement 06/23/2006 Measurement

Maunaloa Finished Water Reservoir 06/26/2007 Measurement 06/23/2006 Measurement

Segment Losses

Total Metered In Total Metered Out Inventory Gains

350,130.0 ( 278,548.5)

71,581.5

As percentage of metered input

 $(71,581.5 / 350,130.0) \times 100\% =$ 

20.444%

As percentage of metered output

 $(71,581.5 / 278,548.5) \times 100\% =$ 

25.698%

10,923.4

Excess Well #17 Water Pumped to the Puunana Raw Water Reservoir - - July 2006 through June 2007 (MPU Fiscal Year 2007)

# Finished Water Delivered to MPU Project Meters

·	584,167,400 <u>354,922,400)</u>	229,245.0
Moana Makani Meter 06/26/2007 Meter Reading 06/23/2006 Meter Reading (	63,825,200 50,052,400)	13,772.8
Total Metered Deliveries to MPU		243,017.8
Calculated Losses through Treatment Plant and (243,017.8 x 0.25698)	l Storage	62,450.8
Required Raw Water From Mahana Pump Stati	on/MIS	305,468.6
Actual Raw Water Deliveries from Mahana Pum 06/30/2007 Meter Reading 07/01/2006 Meter Reading	np 536,121 <u>(219,729)</u>	316,392.0
Excess Well #17 Water Delivery to Puunana Ra Metered Raw Water Deliveries Calculated Raw Water Requirement	w Water Reservoir 316,392.0 ( 305,468.6)	

## Finished Water Delivered to Wai'ola O Molokai (WOM) Meters

1 misrica vvaler benvered to vvarious on	iolokai (**Oivi) ivictors	
Maunaloa Project Meter		
06/26/2007 Meter Reading	813,852,000	
06/23/2006 Meter Reading	(767,875,000)	
	45,977,000	
Less Moana Makani	<u>( 13,772,800)</u>	
		32,204.2
Manawainui Meter		
06/26/2007 Meter Reading	9,757,700	
06/23/2006 Meter Reading	<u>( 6,431,200)</u>	
		3,326.5
Total Metered Deliveries to WOM		35,530.7
Coloulated Language through Transferent Di	ant and Otamana	
Calculated Losses through Treatment Pl	ant and Storage	0 120 7
( 35,530.7 x 0.25698)		9,130.7
Required Raw Water From Mountain Wa	ater Svetem	44,661.4
Required Raw Water From Mountain Water System		77,001.7

Excess Well #17 water as a percentage of calculated raw water requirement from Mountain Water System

(10,923.4 / 44,661.4) x 100% = 24.5%

Water Loss Calculations for Puunana/Maunaloa Water Storage & Treatment Facilities July 2007 through June 2008 (MPU Fiscal Year 2008)

Inputs		
Mahana Pump 06/30/2008 Meter Reading 07/01/2007 Meter Reading	837,939 ( <u>536,121)</u>	
		301,818.0
Mountain Water System 06/23/2008 Meter Reading	74,075,100	
06/26/2007 Meter Reading	<u>( 61,367,000)</u>	<u>12,708.1</u>
Total Metered In		314,526.1
Outputs		
Kaluakoi Project Meter 06/23/2008 Meter Reading	778,732,400	
06/26/2007 Meter Reading	(584,167,400)	194,565.0
Moana Makani Meter		,
06/23/2008 Meter Reading	79,662,400	
06/26/2007 Meter Reading	<u>(63,825,200)</u>	15,837.2
Maunaloa (WOM) Meter		
06/23/2008 Meter Reading	858,227,000	
06/26/2007 Meter Reading	(813,852,000) 44,375,000	
Less Moana Makani	( 15,837,200)	00 507 0
		28,537.8
Manawainui (WOM) Meter	47.040.000	
06/23/2008 Meter Reading 06/26/2007 Meter Reading	15,212,800 <u>( 9,757,700)</u>	
	1,-,,-	<u> 5,455.1</u>
Total Metered Out		244,395.1

## **Inventory Gains**

Puunana Raw Water Reservoir 06/23/2008 Measurement 06/26/2007 Measurement

Maunaloa Finished Water Reservoir 06/23/2008 Measurement 06/26/2007 Measurement

# **Segment Losses**

Total Metered In 314,526.1
Total Metered Out (244,395.1)
Inventory Gains

70,131.0

As percentage of metered input (70,131.0 / 314,526.1) x 100% =

22.297%

As percentage of metered output (70,131.0 / 244,395.1) x 100% =

28.696%

31,038.8

Excess Well #17 Water Pumped to the Puunana Raw Water Reservoir - - July 2007 through June 2008 (MPU Fiscal Year 2008)

# Finished Water Delivered to MPU Project Meters

Kaluakoi Project Meter 06/23/2008 Meter Reading 06/26/2007 Meter Reading	778,732,400 ( 584,167,400)	194,565.0
Moana Makani Meter 06/23/2008 Meter Reading 06/26/2007 Meter Reading	79,662,400 ( 63,825,200)	15,837.2
Total Metered Deliveries to MPU		210,402.2
Calculated Losses through Treatment Plant ( 210,402.2 x 0.28696)	and Storage	60,377.0
Required Raw Water From Mahana Pump S	station/MIS	270,779.2
Actual Raw Water Deliveries from Mahana F 06/30/2008 Meter Reading 07/01/2007 Meter Reading	Pump 837,939 <u>( 536,121)</u>	<u>301,818.0</u>
Excess Well #17 Water Delivery to Puunana Metered Raw Water Deliveries Calculated Raw Water Requirement	301,818.0	04 000 0

## Finished Water Delivered to Wai'ola O Molokai (WOM) Meters

Maunaloa Project Meter

06/23/2008 Meter Reading 858,227,000 06/26/2007 Meter Reading (813,852,000) 44,375,000 Less Moana Makani (15,837,200)

\_\_\_\_\_\_

Manawainui Meter

06/23/2008 Meter Reading 15,212,800 06/26/2007 Meter Reading (9,757,700)

5,455.1

28,537.8

Total Metered Deliveries to WOM 33,992.9

Calculated Losses through Treatment Plant and Storage

(33,992.9 x 0.28696) 9,754.6

Required Raw Water From Mountain Water System 43,747.5

Excess Well #17 water as a percentage of calculated raw water requirement from Mountain Water System

(31,038.8 / 43,747.5) x 100% = 70.9%

#### MPU-IR-WMA-112 Ref: WMA Testimonv-3. p. 2.1.16-18

- a. Provide a complete listing of all small (Revenues under \$2,000,000) water and /or wastewater settled rate applications Mr. Fujino has participated in and provide the estimated and actual rate case expenses for each.
- b. Provide a complete listing of all small (Revenues under
   @ 2,000,000) water and /or wastewater litigated rate
   applications Mr. Fujino has participated in and provide the
   estimated and actual rate case expenses for each.
- c. Provide a listing of all other cases Mr. Fujino has participated in and the estimates and actual rate case expenses for each.
- d. Provide a listing of all cases Mr. Fujino is aware of and the estimates and actual rate case expenses for each.
- e. Define and provide support for what Mr. Fujino considers to be "excessive amounts of money" for
  - 1. A small water and/or wastewater case that is settled.
  - A small water and/or wastewater case that is fully litigated without interveners.
  - A small water and/or wastewater case that is fully litigated with one intervenor.
  - A small water and/or wastewater case that is fully litigated with more than one intervenor.
  - Provide support for the estimates or actual amounts used in the responses above.
- f. Does Mr. Fujino believe that the expenditures for all of the

different cases and parties in the case as shown in part (e) above should be the same?

1. Provide support and rationale for your response.

RESPONSE:

- a-d. Witness Fujino's testimony states that he has not participated in Commission rate proceedings for several years. He recalls working in major rate cases for HECO, MECO, HELCO, Hawaiian Telephone Company and Young Brothers. He does not recall the particular rate requests in which he was involved personally where he testified. Rather, he recalls assisting other staff members for the Division of Public Utilities or the Division of Consumer Advocacy, with regard to preparation of testimonies involving accounting issues, some of which involved water and waste water cases.
- a. For Sub-Parts 1 through 5, it is extremely difficult, if not impossible, to quantify what would constitute an excessive amount, for the five hypotheticals presented. Values for a settled case versus value for a fully-litigated case with or without intervenors can be evaluated not only in terms of the time saved, but also for factors such as the value of pronouncements made by the Commission, after the Commission's first-hand review and assessment of evidence presented at a hearing.
- b. No.

SPONSOR:

Larry Fujino

### MPU-IR-WMA-113 Ref: WMA Testimonv-3. p. 3.1. 2

Provide a detailed calculation supporting the \$100,000 estimate for rate case expense, including:

- Number of hours and burdened pay rates for Company
   personnel for provision of the raw financial and operational
   data required for the application.
- Number of hours and rates for regulatory consultants
   required for the preparation of the application.
- Number of hours and rates for legal work required for the preparation of the application.
- d. Number of hours and burdened pay rates for Company personnel for provision of the raw financial and operational data required during discovery to respond to discovery.
  - Identify and provide hours and costs of how that amount would differ with the increase in the number of interveners.
- e. Number of hours and rates for regulatory consultants required for the work required to respond to the discovery requests.
  - Identify and provide hours and costs of how that amount would differ with the increase in the number of intervenors.
- f. Number of hours and rates for legal work required for the discovery phase of the proceeding.
  - Identify and provide hours and costs of how that amount would differ with the increase in the number of intervenors.

- g. Number of hours and burdened pay rates for Company personnel for provision of the raw financial and operational data required during the rebuttal phase of the proceeding.
  - Identify and provide hours and costs of how that amount would differ with the increase in the number of intervenors.
- h. Number of hours and rates for regulatory consultants required for the work required during the rebuttal phase of the proceeding.
  - Identify and provide hours and costs of how that amount would differ with the increase in the number of interveners.
- Number of hours and rates for legal work required for the rebuttal phase of the proceeding.
  - Identify and provide hours and costs of how that \* amount would differ with the increase in the number of intervenors.
- j. Number of hours and burdened pay rates for Company personnel for provision of the raw financial and operational data required during the hearing and briefing phase of the proceeding.
  - Identify and provide hours and costs of how that amount would differ with the increase in the number of intervenors.
- Number of hours and rates for regulatory consultants required during the hearing and briefing phase of the proceeding.
  - Identify and provide hours and costs of how that amount would differ with the increase in the number of intervenors.
- Number of hours and rates for legal work required during the hearing and briefing phase of the proceeding.

- Identify and provide hours and costs of how that amount would differ with the increase in the number of intervenors.
- m. Please provide Mr. Fujino's estimate for a certified independent audit report for a water company the size of MPU.
  - 1. Provide detailed supporting calculations including:
    - i. Time required for each audit level on the job.
    - ii. Hourly rates used in the estimate.
    - iii. Estimate of Company personnel time and burdened expenses required to provide support for the audit.

**RESPONSE:** The Stipulated Procedural Order entered into and agreed to by MPUI states, in part:

"A party shall not be required, in response to an Information Request, to make computations, compute ratios, reclassify, trend, calculate, or otherwise rework data contained in its files or records." Stipulated Procedural Order, Dated October 28, 2009.

Based on the Agreement, Subitems A through M will not be responded to in the specificity required.

More generally, the \$100,000 is estimated by Witness Fujino to be reasonable rate case expense for rate making purposes. A portion of that conclusion is based upon the efficiency of Robert O'Brian's handling of components of a rate case.

Secondly, one of the apparent reasons for the company's inordinately high

expenses for prosecuting a rate case is the fact that the most recent case was approximately 7 years ago – a period of time which WMA urges be considered reasonable for the amortization of the \$100,000 recommended in this proceeding.

Thirdly, as suggested in WMA's response to MPU-IR-WMA-106, software should have been in place to make much of the compilation of data needed by Mr. O'Brian and his legal counsel much easier, and cheaper, and faster, to access. Good management requires good information readily available. It should not be compiled for the first time, just to respond to Information Requests. .

SPONSOR:

Larry Fujino

MPU-IR-WMA-114 Ref: WMA Testimony-3. p. 3.1. 4-6

Provide a detailed calculation of the number of years Mr. Fujino

believes the inclusion of the automatic adjustment clauses will extend

the period of time between rate cases.

**RESPONSE:** The number of years the inclusion of the automatic adjustment clauses

will extend the period of time between rate cases is not subject to a finite

detailed calculation as requested by WMA.

By its very nature, the automatic adjustment clauses will cause rates to

fluctuate with costs, thereby eliminating the risk of having two of the

largest cost components of the company be over or under provided for

in the Company's rate structure.

This disconnect between costs and rates may not be the only reason,

but is a primary reason that generates the filing of a rate case. By

eliminating or reducing the impact of two large cost components, you

reduce the likelihood of seeking regulatory correction for such cost/rate

disconnection.

SPONSOR:

Larry Fujino

### MPU-IR-WMA-115 Ref: WMA Testimony-3. p. 3.1. 6-8

Provide all supporting data for the use of a seven-year amortization period for the rate case expense.

**RESPONSE:** The following were considered in selecting a seven-year amortization period:

- Period lapsed between last rate increase case filed by MPU 6
   years
- 2. Assumption of automatic adjustment clauses for power and fuel
- 3. Amortization period granted in other water related rate cases, without benefit of automatic adjustment clauses:

Kohala Ranch Water Co. 4 years

Kapalua Water Company 4 years

Hawaiian Beaches Water Co. 2 years

### MPU-IR-WMA-116 Ref: WMA Testimonv-3. p. 3.1.11-13

- Define and provide all of the components on what Mr. Fujino
   means by "under normalized conditions."
- b. Provide each element that Mr. Fujino believes are not normalized conditions.
- c. Show how each of those elements contributed to the difference between the rate case expense actually incurred and Mr. Fujino's estimate of a "reasonable amount".

RESPONSE: a – b. The term "under normalized conditions" was used to refer to the regulatory rate setting process of projecting expenses for a test year with the test year expenses conforming, as much as can be reasonably projected, to a degree of regularity, and more so, absent abnormalities.

As applied to the estimation of regulatory expenses, I restate my question in my testimony – "What is a reasonable amount for MPU for regulatory matters for the 12 month period of time used to evaluate reasonable expenses under normalized conditions (the test year)?

I do not question that MPU may spend in excess of \$300,000 in this rate case. However, to accept that amount as a projection of a recurring expense in this instant test year is to accept the deficiencies that initiated these costs, as deficiencies to be expected in a future rate case that MPU presents. These deficiencies are well documented by other testimonies referring to conflicting and unavailable data compounded by a change in accounting procedures thereby removing access to

comparable historical data, resulting in significant increase in IRs, SIRs and regulatory expenses. I have therefore attempted to project regulatory costs absent these deficiencies.

C – see response to a, b.

Also considered in estimating "reasonable amount" was a review of approved amounts in prior rate cases of water related companies:

- Kohala Ranch Water Company \$147,000, 7.6% of revenues,
   4.7% of rate base
- Kapalua Water Company \$164,000, 8.8% of revenues, 8.6% of rate base
- Hawaiian Beaches Water Co. \$139,600, 16% of revenues, 10.5%
   of rate base

### Proposed:

Molokai Public Utilities \$100,000, 11.4% of revenues, 10% of rate
 base

### MPU-IR-WMA-117 Ref: WMA Testimonv-3. p. 6.1. 23. p. 7.1.1-3

- a. Provide all the data on demographics, lot sizes, remoteness/concentration/proximity, values of the property with and without access to potable water, terrain/pumping requirements, size/length of water mains, and all other factors considered.
- Explain with particularity and in detail how these data led to spreading the capacity revenue requirements as proposed by WMA.

**RESPONSE:** 

- Attached hereto and incorporated herein are the sheets of data requested which are easily legible.
- b. The data contained in Attachment reflect considerable effort to conform costs to MPUI's current design of tariffed categories, i.e. meter size. After much research some in the field it was determined that MPUI has failed to adhere to its own tariff. So WMA gave up its effort to conform to the current tariff design. Other non-demographics, such as fixed costs and variable costs led to the spreading of the capacity revenue requirements indicated in the WMA-supposed tariffed rates for MPUI.

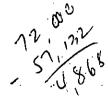
# TO WMA'S RESPONSE TO MPU-IR-WMA-117

(15 PAGES OF SOME SOURCE DOCUMENTS AND RELATED WORK PAPERS)

# MOLOKAI PUBLIC UTILITIES, INC. 2003 Test Year Water Usage

	L L	Vater Usage 1,000 gallons		11	Differences ,000 gallon	
Categories	MF		<del>/</del>	MPUI	D(	
•			DCA	Revised -	. from	from
	Original	Revised	٠,	Orig.	Original	Revised
County of Maul Beach & Parkside	4,368	4,800	5,604	432	1,236	804
KWLLC Golf Course	(72,000	57,132	57,132	(14,868)	(14,868)	
KWLLC Hotel	4,800	7,200	7,992	2,400	3,192	792
West Molokai Resort	9,600	12,000	12,132	2,400	2,532	132
Ke Nani Kai	15,876	15,876	15,876		•	•
Panilo Hale	12,144	12,072	13,044	(72)	900	972
Papohaku Subdivision 1/	61,524	58,212	60,252	(3,312)	(1,272)	2,040
Moana Makani Subdivision 1/	9,120	8,892	8,352	(228)	(768)	
Fairways Subdivision	1,176	1,536	1,632	360	456	96
Total customer sales	190,608	177,720	182,016	(12,888)	(8,592)	4,296
Bulk sales to Waiola O Molokai	19,200	27,200	27,200	8,000	8,000	•
TOTAL	209,808	204,920	209,216	(4,888)	(592)	4,296

11 Adjusted for customers using Wailoa O Molokai water.
Source: MPUI: Application and response to CA-SIR-5; DCA: Exhibit CA-WP-203.



### MOLOKAI PUBLIC UTILITIES, INC. 2003 Test Year Revenues at Present Rates

	Revenu	es at Preser	nt Rates	Differences			
Categories	MF	וטי		MPUI.	DCA		
	Original	Revised	DCA	Revised - Orig.	from Original	from Revised	
County of Maui Beach & Parkside	9,312	10,152	11,712	840	2,400	1,560	
KWLLC Golf Course	141,480	111,732	111,732	(29,748)	(29,748)	•	
KWLLC Hotel	12,312	17,220	18,756	4,908	6,444	1,536	
West Molokai Resort	20,256	24,912	25,164	4,656	4,908	252	
Ke Nani Kai	33,804	33,972	33,972	168	168		
Panilo Hale	25,356	25,476	27,360	120	2,004	1,884	
Papohaku Subdivision 1/	132,342	126,720	131,346	(5,622)	(996)	4,626	
Moana Makani Subdivision 1/	19,704	19,398	18,204	(306)	(1,500)	7	
Fairways Subdivision	2,928	3,636	3,816	708	888	180	
Total customer sales	397,494	373,218	382,062	(24,276)	(15,432)	8,844	
Bulk sales to Waiola O Molokai	14,400	20,400	20,400	6,000	6,000	• /	
TOTAL	\$411,894	\$393,618	\$ 402,462	(18,276)	(9,432)	8,844	

1/ Adjusted for customers using Walloa O Molokai water.

Source: MPUI: Application and response to CA-SIR-5; DCA: Exhibit CA-WP-203.

## MOLOKAI PUBLIC UTILITIES, INC. DCA 2003 Test Year Forecasts

		Present		*	Proposed	% Increase
Customer water sales (1,000 gallons)		182,016	. •		182,016	
Rate per 1,000 gallons	\$	1.94		\$	3.00 2	/ 54.6%
Water sales	<b>,\$</b>	353,136	1/	\$	575,616 3	/ 63.0%
Bulk water sales (1,000 gallons)		27,200	•		27,200	
Rate per 1,000 gallons	\$	0.75			1.125	50.0%
Bulk water sales	\$	20,400		\$	30,600	50.0%
Standby charge	\$	22,782	,	\$	34,173	50.0%
Fire protection charge	\$	672		\$	1,008	50.0%
Water availability charge	\$	5,472		\$	8,208	50.0%
Total revenues	\$	402,462		. \$	649,605	61.4%

<sup>1/</sup> Sales based on aggregate of individual sales and may differ with totals due to rounding.

<sup>2/</sup> Based on 50% increase of present rate of \$1.94 (1.94  $\times$  1.5 = \$2.91) rounded to \$3.00.

<sup>3/</sup> Total water sales includes conservation rate of \$3.55 applied to residential usage above 30,000 gallons per month.

# ATTACHMENT CA-IR-54 (Part F) Docket No. 2009-0048 Page 1 of 5

Exhibit MPU 11.1

Molokal Public Utilities, Inc. Summary Usage, and Customer Counts Test Year Ending June 30, 2010

### Summary -- July 2007 to June 2010

		[1]	[2]	[3]	[4]	[5]
			Six Month	s Ended		Year
Line #	Description	12/31/07	6/30/08	12/31/08	UPDATE: 6/30/09 · 1	Ended 6/30/10
<u>5/8"</u>	meter (200)					
1	Gallons billed in 000 gallons	37,055	34,964	17,004	•	•
2	# of customers for Usage Billing	1,121	1,141	590	0	0
3	Average Usage per Customer (000) (L 1 / L 2)	33.1	30.6	28.8	<u> </u>	•
1.0"	meter (201)- MIS					
4	Gallons billed in 000 gallons	12,873	12,854	13,374	11,010	26,000
5	# of customers for Usage Billing		6	6	6_	12
6	Average Usage per Customer (000) (L 4 / L 5)	2,145.5	2,142.3	2,229.0	1,835.0	2,166.7
)**	meter (202)					
7	Gallons billed in 000 gallons	7,118	6,267	2,163	•	-
8	# of customers for Usage Billing	6_	6_	3	0	
9	Average Usage per Customer (000) (L 7 / L 8)	1,186.3	1,044.5	720.9	<u></u>	
1.5"	meter (203)					
10	Gallons billed in 000 gallons	9,309	9,983	3,794	-	-
11	# of customers for Usage Billing	12	12_		0	0
12	Average Usage per Customer (000) (L 10 / L 11)	775.8	831.9	632.3	<u></u>	-
2.0"	meter (204)					
13	Gallons billed in 000 gallons	4,880	4,202	2,013	-	-
14	# of customers for Usage Billing	12	12_	6	0	0
15	Average Usage per Customer (000) (L 13 / L 14)	406.7	350.2	335.5		<u>.</u>
	meter (205)					
16	Gallons billed in 000 gallons	30,120	16,754	65	-	-
17	# of customers for Usage Billing	18	18_	9	0	0
18	Average Usage per Customer (000) (L 16 / L 17)	1,873.3	930.8	7.2	<del> </del>	<u> </u>

# ATTACHMENT CA-IR-54 (Part F) Docket No. 2009-0048 Page 2 of 5

Exhibit MPU 11.1

Molokal Public Utilities, Inc. Summary Usage, and Customer Counts Test Year Ending June 30, 2010

### <u>Summary -- July 2007 to June 2010</u>

		[1]	[2]	[3]	[4]	[5]
			Six Months	s Ended_		Year
Line #	Description	12/31/07	6/30/08	12/31/08	UPDATE 5 6/30/09 5	Ended 6/30/10
4.0"	meter (206)					
19	Gallons billed in 000 gallons	2,523	1,555	568	•	•
20	# of customers for Usage Billing	42	42	21_	0	0
21	Average Usage per Customer (000) (L 19 / L 20)	60.1	37.0	27,0		
<u>"ÇÇ</u>	<del>-</del>					
22	Gallons billed in 000 gallons	4,637	3,710	2,006	•.	-
23	# of customers for Usage Billing	6_	6	3	0	0
24	Average Usage per Customer (000) (L 22 / L 23)	772.8	618.3	668.6		•
1	(100)					
_5	Gallons billed in 000 gallons	•	•	•	•	•
26	# of customers for Usage Billing	0	0	2	0	0
27	Average Usage per Customer (000) (L 25 / L 26)		<del> </del>	•		-
KW	A (2000)					
28	Gallons billed in 000 gallons	•	-	31,559	47,107	112,000
29	# of customers for Usage Billing	0	0	638	1,252	<del></del>
30	Average Usage per Customer (000) (L 28 / L 29)	•	,	49.5		
<u> 101</u>	AL EXCLUDING KUALAPUU					
31	Gallons billed in 000 gallons	95,642	77,435	59,172	47,107	112,000
32	# of customers for Usage Billing	1,217	1,237	1,278	1,252	2,560
33	Average Usage per Customer (000)	78.6	62.6	46.3	37.6	43.8

RCM MPU 0-29-08.sls

# ATTACHMENT CA-IR-54 (Part F) Docket No. 2009-0048 Page 3 of 5

Exhibit MPU 11.1

Molokal Public Utilities, Inc. Summary Usage, and Customer Counts Test Year Ending June 30, 2010

### Summary -- July 2007 to June 2010

		[1]	[2]	[3]	[4]	[5]
			Six Months	s Ended		Year
Line #	<u>Description</u>	12/31/07	6/30/08	12/31/08	UPDATE - 6/30/09 //	Ended 6/30/10
<u> 101</u>	AL ALL					
34	Gallons billed in 000 gallons	108,515	90,289	72,548	58,117	138,000
35	# of customers for Usage Billing	1,223	1,243	1,284	1,258	2,572
38	Average Usage per Customer (000) (L 31 / L 32)	88.7	72.8	58.5	48.2	53.7
CUST	OMERS					
37	# of Customers (1) CC	6	6	3		3
38	# of Customera (100) WA	-	4	5		5
•	# of Customera (201) MIS	•	-	6	6	6
40	# of Customers (250)	1,148	1,160	1,199	1,185	2,398
41	# of Customers (251)	6	6	6	6	12
42	# of Customers (253)	. 6	6	6	6	12
43	# of Customers (254)	18	18	18	19	36
44	# of Customers (255)	12	12	13	12	26
45	# of Customera (257)	33	32	30	30	60
46	# of Customers (258)	14	12	12	12	24
47	# af Customers (260) TPI	3	<u>.                                    </u>	20	2	-
48	Total Customers For Monthly Charge	1,244	1,256_	1,318	1,278_	2,582

RCM MPU 0-20-00 Ms

ATTACHMENT CA-IR-84 (Part F)
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Exhibit MPU 11.2

Melukui Public Utilities, Inc. Summary Ucage, and Casterner Counts Test Year Ending June 30, 2010

		£1]	[2]	13]	[4]	[5]	[6]	[7]	[0]	[9]	[10]	[11]	[12]	[13]
Line					2008					2009			<del></del>	Fiscal Year UPDATE
-	Description	July	Aug	Sept	<u></u>	Nov	Dec	<u>Jan</u>	Feb	Mar	Apr	May	June	6/30/09
	meter (200) Gallons billed in D00 gallons	6,702	0,117	2.185										17.004
	-		·			_	_	_	_	_	_		_	
2	# of customers for Usage Billing	197	197	196			0					0		590
	Average Usage per Customer (000) (L. 173. 2)	34.0	41.2	11.1	<del></del>	<del></del>	<del></del>	<u> </u>	-	<del></del>		<del></del>	<del></del> :	28.8
	meter (201)- MIS Gallons billed in DCO gallons	2,222		5,300	1,979	2,219	1,654	1,871	1,806	1,949	1,874	1,942	1,568	24,384
5	# of customers for Usage Billing	1		2	1	1	1	1	1	1	<u>t</u>	1	1	12
6	Average Usage per Customer (000) {L 4 / L 5}	2,222.0	#DIV/DI	2,650.0	1,979.0	2,219.0	1,654.0	1,871.0	1,806.0	1,949.0	1,874.0	1,942.0	1,568.0	2,032.0
	meter (202) Gallons billed in 000 gallons	692	875	596										2,163
	# of customers for Usage Billing	1	1	1					0					3
•	Average Usage per Customer (000) (L.77 L.8)	692.0	875.0	596.0	<del></del>		<u> </u>	<del></del>	<u> </u>			<u> </u>	<u></u> :	720.B
<u>1.5°°</u> 10	meter (203) Gallons billed in 000 gallons	1,486	1,751	547										3,794
11	6 of customers for Usage Biffing		2	2	0						0			6
12	Average Usage per Customer (000) (L 10 / L 11)	743.0	880.5	273.5	<del></del>	<del></del>	<u>-</u>	<u> </u>	•	_ <del></del>	<u> </u>		<del></del>	632.2
	meter (204) Gallons billed in 000 gallons	736	960	317										2,013
14	# of customers for Usage Billing	2	2	2	0						0	0		6
15	Average Usage per Customer (000) (L 13 / E 14)	368.0	480.0	158.5	<u></u>		-	<del></del>		<u></u>	<u> </u>	<del></del>	<u> </u>	335.4
	<u>meter (205)</u> Gallons billed in 000 gallons	24	29	12										65
17	# of customers for Usage Billing	3	3	3_					0	0	0	0		9
18	Average Usage per Customer (000) (L 16 / L 17)	80	9.7	4.0	<del></del>		<del>.</del>	<del></del>	<del></del>	<u></u>		<u></u>		7.2
4.0 <sup>-</sup>	meter (206)	314	176	4,835 78										568
20	Ø of customers for Usage Billing	7		7_	0		0	0		0	0	0		21
21	Average Usage per Customer (000) (L 19 / L 20)	44.9	25.1	11.5	<u>—</u> —		<del></del>	<u></u>	<del></del>	<u></u>	<del></del>	<u> </u>	<del></del>	27.0

\*\*\*\*\*\*\*



ATTACHMENT CA-81-54 (Part F)
Deckut No. 2008-0848
Page 5 of 5

Exhibit MPU 11.2

Mointel Public teleties, Inc. Summery Usage, and Customer Courts Yest Year Ending June 30, 2010

		[1]	(2)	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[15]	[12]	[ 13 ]
Lime					2008				<u> </u>	2009	· · · · · · · · · · · · · · · · · · ·	9 1 m 3	<del></del>	Fiscal Year UPDATE
•	Description	July	Aug	Sept	Od	Nov	Dec	Jan .	Feb	<u> Mar .</u> .	Apr	May	June	6/30/09
<u>TCC</u>				_										
22	Gallons billed in 000 gallons	753	956	297										2,006
23	# of customers for Usage Silling	1_	1		0	0	0	0	0					3
24	(L 22 / L 23)	753.0	956.0	297.0	<del></del>	<del></del>	<del></del>	<u>-</u>	<del></del>	<del></del>	<del></del>	<u> </u>		668.5
<u>WA</u> 25	(100) Gallons billed in 000 gallons	-	-											-
26	# of customers for Usage Billing		1	1	0					0		0	<u>D</u>	2
27	Average Usage per Customer (000) (L 25 / L 25)	<u>.                                  </u>		<u>·</u>	<del></del>	<del></del>	<del></del>	<del></del> :		<del></del>	<del></del>	<u> </u>		<del></del>
KWI	A (2000)													
	Gallons billed in 000 gallons	-	-	8,595	9,712	8,786	4,466	4,846	5,560	8,454	9,253	9,507	9,487	78,665
29	# of customers for Usage Billing	0	0	210	206	207	213	207		209	209	209	209	2,090
34	Average Usage per Customer (000) (L 28 / L 29)	<u></u>	<del></del>	40.9	45.7	424	21.0	23.4	26.6	40.4	44.3	45.5	45.4	37.6
101	AL ALL Gallons billed in 900 gallons	12,929	12,874	17,927	11,691	11,005	6,120	6,717	7,366	10,403	11,127	11,449	11,055	130,663
32	# of customers for Usage Billing	214	214	213	209	208	214	208	210	210	210	210_	210	
34	Average Usage per Customer (000) (L 31 / L 32)	60.4	60.2	84.2	55.9	52.9	28.6	32.3	35.1	49.5	53.0	54.5	52,6	51.6
Num	ber of Customers for Monthly Cherge													
34	# of Customers (1) CC	1	1	1		•	•			•				3
35	# of Customers (100) WA	1	1	1	•	1	1							
36	# of Customers (201) MIS	1	-	2	1	1	1	ı	1	1	1	1	1	12
37	€ of Customers (250)	203	205	201	197	196	197	196	198	197	197	199	198	2,384
38	# of Customers (251)	1	1	1	1	1	1	1	1	1	1	1	1	12
30	6 of Customers (253)	1	1	1	1	1	1	1	1	1	1	1	1	12
40	# of Customers (254)	3	3	3	3 ATTACHMENT CA	3	3	3	4	3	3	3	3	37
41	# of Customers (255)	3	2	2	2	2	2	2	2	2	2	2	2	25
42	Ø of Customers (257)	5	5	5	5	5	5	5	5	5	5	5	5	60
43	# of Customers (258)	2	2	2	2	2	2	2	2	2	2	2	2	24
44	# of Customers (260) TP1	14	6				-		1	1				22
Ø	Total Customers For Monthly Charge	233	225	217	212	211	212	211	215	213	212	214	213	2,588

		MPU			·	Attachment CA-IR-37	1-hold	1501
	Mahana F	Omp Monthly	Useage in K ga	illons			- Well	O.
Date	Beginning	Endir	ng (	Jseage		200	W down - 86,73!	_
Jan-	2008 -	1098753	1132994	•	34241	n live	Was I	THE TOTAL
Feb-2		1132994	1155503	•	22509	Burn	LATE TO VIEW	
Mar-		1155503	1163430		7927	/~		
Apr-2		1163430	1174745		11315			/
May-		1174745	1190355		15610	1	80,73	7
Jun-		1190355	1219729		<del>29374</del>			
	2006	219729	250692		30963	0		· 
Aug-2		250692	280726	\	30034		,	<sub>1</sub> ζΥ ]
Sep-2		280726	308361	1	27635		<b>~</b> ().	2299 22 22,43,72 12,43,72 1,208+
Oct-		308381	331783	1	23422	10	RN	134 120c
Nov-2		331783	350775	-	18992		<b>*</b> /	
Dec-2		350775	372139	1	21364	X Q I		11
Jan-2		372139	400405	1	28266	<b>3</b>	YM.	(A)
Feb-2		400405		1	25009		1 .	2,41
Mar-2			425414	1	26294		- 1	201 909
Apr-2		425414 451708	451708 481887	ľ	30179		1.	1/10/24
May-		481887	514770	İ	32883		. (6)	كالمستنبسل
Jun-2		514770	536121	1	21351	<b>⊿</b> .	741	28 mo
	2007	536121	553855	1	17734	<i>γ</i> . (1,	1	120/
Aug-2		553855	587260		33405	الر " 5	1,480	
Sep-2		587260	615469	/	28209	/nl	1,9/	60 K/MO)
Oct-2		615469	652084	1	36615	6	1/22.10	60 7/11
Nov-		652084	675716		23632	•	( 2010	, <u>, , , , , , , , , , , , , , , , , , </u>
Dec-2		675716	695180	[	19464			
Jan-2		695180	716911		21731	•	My Sh	7 Lucon
Feb-		716911	744015	[	27104			Lagory
Mar-		744015	776362	· ·	32347	erv v	1. 14 70	, included the second of the s
Apr-		776362	798497_	· ·	22075	_104\//	WW /   man /	1
May-		798437	819308	-	7 20871	LOOKS THE IRPIG	MIRE	1
Jun-		819308	837939	ما	518631	1.016	with JA 1	
	2008	837939	859326	1 ~ 1 \ \	121387	to the	EXPLY	1
Aug-		859326	881196	85'y,	21870	TOOKS BKE I KEIE		877545
Sep-		881196	895369		14173	Stoller .	SAL.	27751.66
Oct-		895369	910626	1	15257			S J WALL
Nov-		910626	921622	1	10996	The same of the sa	Man 1. In	13/6/17/0
Dec-		921622	932689		11087	/	/16 mid	12.
Jan-		932689	941508	1	8819	2 10	7 110	1
Feb-		941508	951570	1	10062	1191	- 1) .	
Mar-		951570	965097	1	13527		- 7 k	
Apr-		965097	976442	1	11345		166	1 11/
May-	•	976442	990457	1	14015	11	, 40,	~#\!\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\
Jun-		990457	1006288	1	15831	16	11 17	_ / // //
		1006288	1022475	1	16187	· ·	// v / /	
Aug-		1022475	1038413	1	4 5938,	shut	- 1	
				/	MAKIC	) spur	1000	
1		<b>A</b> 1 -		/	- ·	100 1/1 100	1, 1, 6	-pi-5101',
2/24/13	Du Kal	D NOLILATO 1	elvul duvo	n' 2	, 77,4	W. KINGA	100人 こう5	ERIGATION.
	the said	y and an	4 - may add ad.		. <u>'</u>	227/4/11	` '	268,964
71 "	V . (	}		1	162,	0124M.	2 5 WM -	268964
11/27	MANN "	, ,	•	/		- Jul	001	21/206W
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						911	•	7''
								•

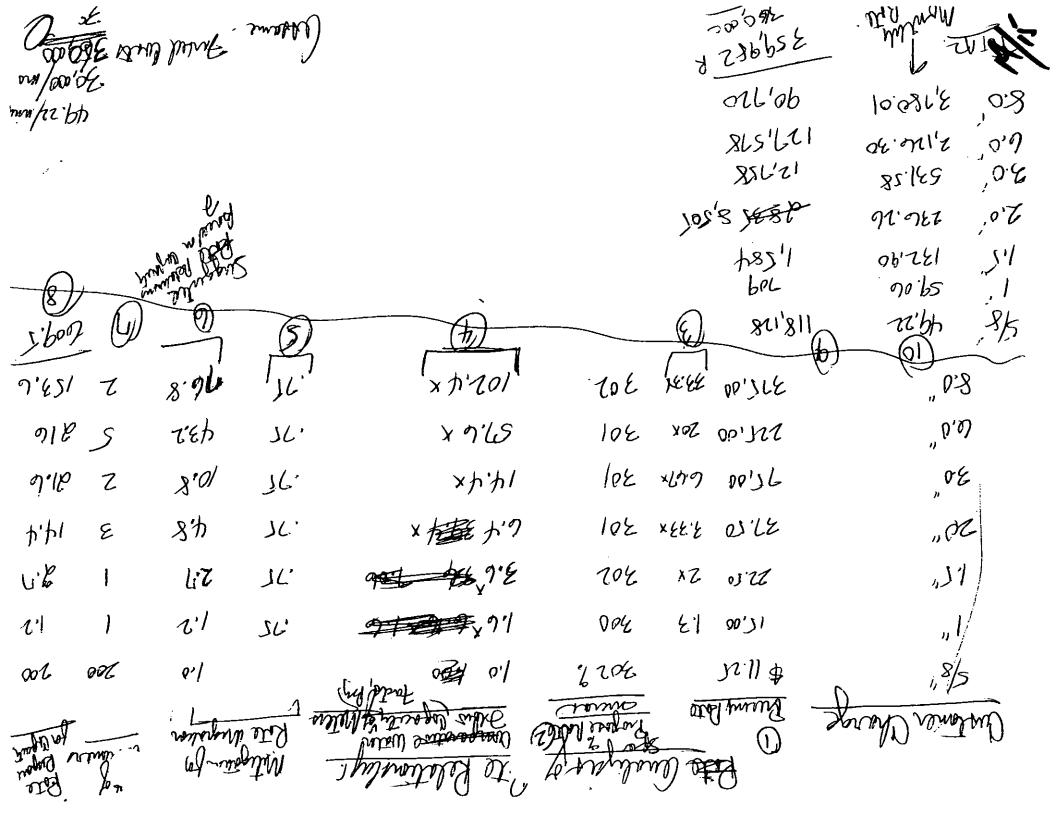
jer DAO by CWAM: allocations of Well 17 Conter - gol. 0, 1110 Gordo. 184,000 e. Ç Rendential 51,000 6.0 G. Come, 400,000 47.2 Beach Park 26,000 2,0 2.1 Nursery 15,000 Filter Backwork 100,000 11.8 System Toes ه و ر Kava kon Sur Total 844,000 833 MIS Uprage Clarge 94,000 Knalagen Town 76,000 9.2-40 **), 0** Total 1,018,000

Present Rate 15,00 22.50 75, 225 Viogosed Rote. 678 1,131 6800 34.00 % Incuare 302 300 301 302 302 :301 301 Muliple of Premy Base Notte Nation 1/24 1.0 4.0 Water Flow Capacity Factor, By Million Thoposed Mitigation For Rote Mighation Is Cogauty Costs. 4022 10.8 3,06 Capacity Joseph By 1.0 153.59 # of Customers Gorecasted 201.6 3.06 Rate Kenswelly, By Cologory Kevenue Squeement, By Conflittigory 157,872 Monthly Rote 13240 By Cost Cotegory 220 43.00 132 MPU Elluber TURCUS ! Beganne CA-IR 82(0)

	No. of	5.33			assumed	Billable Units by Weighted	
	Residential — Units/Land Parcels	Est. No. of Improved Properties	Est. No. of Vacant Units/Parcels	Est. No. 8 Est. Meters No.	Est. Meters Size	Demand on  System's Capacity	
Papohaku Ranchlands	274	SE 58	208216	69 58	5/8" - 2	5/8"	225 dellableunts/me
Moana Makani	32	4	28	4	5/8" - 47	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	
Fairway Lots	itin 16	8	8	8	5/8" - 7"	/,0	2.11
Kaluakoi Villas	148	148 - 4	arete	W.	1"	1,5"	7.8
Ke Nani Kai Condos	120	120	950	\ \rightarrow{1}	. 8"	00"	13.56
Paniolo Hale Condos	780000	78		1	6 <sup>†</sup>	2.0	17.30
Kaluakoi Hotel	50 144		144	2	6"	3.0	48.66
County Beach Park	1	1			A" 3/8	4.0"	178.36
County Beach Access Facilities	6	6	•	6,	4848	, 0	
Golf Course	1	1		* 3	3"	TOTAL	475.5
SUBTOTAL	<b>820</b> ·	432	388	232			
							·
	12				{		
	1/1"						



			·	
	proposal.	guyand:	Umto belkel	Kevenne
5/2	934	57, <b>\$0</b>	225	JS5,134
1.0	45	121.23		1,455
1,5	68	224	V	5,378
2.0	113	390	V	9,350
3.0	226	932	3	33,552
4.0	340	1,464	7	122,981
Verraumer	Services ()	house		25,056
	• (	cometer/mo.	232	27,455
usease!	hage.	93.18/16	112,000	356,160
				13/15



# unils ando 24,560 118,200 Beach link (myror Par acuso (2 lond;

### MPU-IR-WMA-118 Ref: WMA Testimonv-3. p. 7.1.11-13

Is WMA's proposed rate structure an attempt by WMA to penalize or punish MPL for closing the golf course in 2008 and not re-opening the Kaluakoi Hotel? Please fully explain your response.

RESPONSE: No.

The proposed rate structure is designed to align as closely as the data would permit fixed costs to fixed charges and variable costs to usage charges.

MPU-IR-WMA-119 Ref: WMA Testimony-3, p. 7.1.15-17

a. Explain what is meant by "customers ... who have MPU's

facilities making potable water readily available."

b. Identify these customers.

RESPONSE: WMA's rate structure is designed to capture revenues from two sub-

classes of customers who are not paying their fair share of fixed costs.

Sub class one are those owners of parcels of land which have not yet

been improved, but have facilities transporting potable water to their

premises, which access to potable water has greatly enhanced the value

of their property. For them to become consumers of water, the only thing

additionally needing to be done is the connection charge and connection

services, including the installation of the meter.

The second sub class of customers are those who have actually used

MPUI's facilities, but have terminated regular service. Two of the known

former consumers of water who are no longer customers generating

usage are the golf course and the Kaluakoi Hotel.

SPONSOR:

Larry Fujino

### MPU-IR-WMA-120 Ref: WMA-302

Why does WMA-302 reflect the 8 employees shown on MPU's workpaper 10.1 of its original filing for its calculations of salaries, wages, payroll taxes and benefits ("S&W") instead of the 6 employees addressed in responses to IRs and SIRs and as noted in Mr. Fujino's testimony (WMA Testimony-3, p. 4,1. 8)?

RESPONSE: There may have been subsequent changes to MPU's original filing for its calculation of salaries and wages reflecting eight employees. However, for my illustrative workpaper illustrating job/cost duties converted to time/labor costs, the salaries and wages, including wage increases and labor hours as originally filed by MPU were used.

### MPU-IR-WMA-121 Ref: WMA-302

- a. Identify any other functions (other than those listed on Exhibit WMA 302), page 2 of 2 required for the safe and reliable operation of a small water company.
- If none can be identified, please explain how the following functions, services or elements would be provided to serve customers:
  - 1. Preparation of payroll
  - 2. Employee insurance
  - 3. Customer billing
  - Receipt and recording of customer payments for utility service
  - 5. Ordering of required materials and supplies
  - 6. Ordering and monitoring of construction expenditures and other plant additions

### RESPONSE:

- a. There may be other functions to be included on the list on P. 2 of my Exhibit WMA-302, but I will stand by the items included on that list.
- b. It is my understanding that the items listed in this Information Request are either being performed by MPL in its corporate headquarters in Honolulu, Hawaii, or are tasks which are relatively minor time-consuming factors in the overall operation of a public utility company.

### MPU-IR-WMA-122 Ref: WMA-302

- a. Please explain if the quantity and man-hours shown on Exhibit WMA 302, page 2 of 2 include the inclusion of plant additions for new meters, a lateral replacement tool and other items.
  - 1. If the response to part (a) above is positive, explain how the labor related to those labor savings tools can be included in the test year ended June 30, 2010 when it is over one-half completed and those labor saving tools have not been acquired and will likely not be acquired until late in the test year.
  - If the labor savings from the use of the tools is included in the test year, explain why 100% of the new plant is required to provide that savings.
- b. Confirm that the 5,953 hours shown on line 14 reflects slightly less than 3 full time employees for MPU.
  - Does WMA propose that only 3 employees be used by MPU?
  - If not, describe how many employees would be required under WMA's recommendation.
  - If not, describe how the other time for the total number of employees would be recovered.
- c. Explain, using only the hours provided in Exhibit WMA 302 how the Company could possibly perform the systematic maintenance activities called for by Mr. Marusich in his

testimony (WMA Testimony-2, p. 5,1. 19).

- d. Provide support for the 10% contingencies on line 11.
- e. Provide support for the 10% of paid absence.
- f. Explain how the Company would provide for backup during vacation periods, illness or other events.

RESPONSE: a.1. Installation of a large number of new meters, in my opinion, is a capital expense, not a routine maintenance item. Therefore, all labor and materials associated with this and similar systematic improvements would be capitalized, and not included in the maintenance budget.

WMA is completely in favor of MPU's purchase and use of Lateral Replacement Tool as soon as possible. Any procedure that prevents further cutting, cold patching and subsequent degradation of the existing roadways meets with the approval of all who travel along these (more or less) paved surfaces.

- a.2. Question is unclear. Lateral replacement tool and, perhaps, new air compressor and tools are the only labor saving items included in the new plant additions proposed for the Test Year. Total estimated cost of these items is only \$5,500, certainly not 100% of the new plant.
- Labor man hours proposed by MPU in its application were based on an allocation of time charges by MPL's employees to the three

utility companies. Full time employees for each individual regulated utility company were never mentioned in this proceeding or, to the best of WMA's knowledge, in any other open proceeding (2008-0115 and 2009-0049). Indeed, MPU, WOM, Mosco and MPL have always taken the position that the allocation of labor from a larger pool of employees is more cost effective than separate staffing for each regulated utility company. Does this information request reflect a reversal of prior policy?

- b.1 No.
- b.2 See response to b. above.
- b.3 See response to a.1 above.
- Mr. Marusich did not delineate systematic maintenance activities
  in his testimony or in his response to MPL-IR-WMA-107.
   Improvements having a long useful life, such as the meter
  replacements included in MPU's new plant additions for the Test
  Year, are properly capitalized and depreciated.
- d. Contingencies of 10% for unforeseen events and emergencies are deemed to be reasonable, given the lack of data provided as to the employees' specific assignments and duties.

e. Paid absence of approximately 10% is based on 80 hours of vacation, 10 paid holidays and 30 hours of sick leave per employee per year. Calculations are as follows: [190 / (2080 – 190)] x 100% = 10.05%

f. See response to b. above.

### MPU-IR-WMA-123 Ref: WMA-304

Explain why, if all tax amounts should be removed, per the response to CA-SIR-20, why the rate base reduction for HCGETC should not be removed also.

**RESPONSE:** The rate base reduction for HCGETC should be removed if there is agreement by all of the parties with MPUI's proposal to eliminate income tax effects from this rate case. WMA can calculate the value, but is not required to do so. [Refer, to Response to MPU-IR-WMA-113(a)]

> Such an adjustment would change the Average Rate Base amount of \$996,161 on line 28 Exhibits WMA 101 and 304. Eliminating the HCGETC reduction of \$199,317 will result in a change in the Average Rate Base from \$996,161 to \$1,195,478. This will also change the value on Line 29 (Return on Rate Base) from 2.01% to 1.68%.

Since WMA is not considering return on rate base in any of its testimony, the adjustment is of no consequence to WMA's presentation.

The DCA is also proposing new rates without any return on rate base. when it proposes a near breakeven for operating income. Both WMA and DCA appear to take the position that MPUI be placed on a cashflow mode of operation until such time as long overdue remedial actions to the system are actually taken.

SPONSOR:

Larry Fujino

### MPU-IR-WMA-124 Ref: WMA-305

Provide all support for the calculation of each rate on Exhibit WMA 305:

- a. Provide square foot areas for each of the improved and unimproved parcels.
  - Explain why the monthly customer charges for the improved and unimproved parcels are different.
- 2. Provide calculations that support the differences.
- 3. Provide the map used to identify the location of each parcel or explain how the numbers for each group were identified.
  - b. Provide square foot areas for each condominium and hotel unit.
- Explain why the monthly customer charge for each condominium unit and hotel unit should be the same.
- Provide estimate of water used for each size condominium unit and for each size of hotel unit.
  - c. Provide all data supporting the monthly fixed charge for the golf course.
    - Explain how this calculation relates to the calculation of the monthly charge for each other parcel or unit shown on the exhibit.
  - d. Explain why the wholesale monthly rates shown in section B are different.
  - Explain why those monthly rates are approximately one-half
     of the monthly rate for the golf course.

**RESPONSE:** Square footage is not known for each of the improved and unimproved parcels. Such information is best obtained from MPL, another party to

this proceeding.

- a-1. Monthly customer charges for owners/users of improved parcels is proposed to be \$14.50 higher than for owners/users of unimproved parcels. This difference is due to consumers (vis-à-vis customers) being provided some additional ancillary services such as meter reading and usage, billing services, postage, record keeping, etc. WMA understands that at the present time, each of the consumers is charged \$11.25 per month for the services for which WMA is effectively proposing \$14.50.
- Please refer to the quotation contained in WMA Response to MPU-IR-WMA-113, taken from the Stipulated Procedural Order.
- 3. However, the numbers for each group were identified through substantial effort to break down the number of customers, the number of consumers, and the number of consumers and/or customers that are part of the service area, generally, and the condominium complexes, in particular. What is most disconcerting is the apparent irreconcilability of MPUI's tariffed rates (i.e. by meter size) with customers who are known to have meters different from the billing records. Bills appear to not conform to the tariffs.
- b-1. The proposed customer charge for condominium includes water consumed for showering, bathing, washing laundry, and other household functions. The same rate was

proposed for a hotel unit, because there is no practical way to break out and differentiate a single hotel unit's water consumption for showering and cleaning, on the one hand, and the water indirectly consumed by hotel guests for their non-occupancy in a hotel room unit, including common uses for such things as swimming pool, restaurants, irrigation for landscaping, etc. It is believed that unitizing the proposed rate for both condominium units and hotel units may in some fashion favor the hotel.

b-2. Refer to my response to b-1., above.

### MPU-IR-WMA-125 Ref: WMA-305

- Explain and show the specific support for the calculations of the consumption charges.
  - Provide detailed description on the differences in the two rates.
  - Explain why the Kaalapuu Town and Water Treatment
     Processing should be charged the wholesale rate for water usage.
  - Explain why the golf course should not be charged the wholesale rate.

### RESPONSE:

1-2. Water delivered to non-commercial customers delineated on WMA's proposed tariff for MPUI are at a retail level, and may involve several hundred billings, if WMA's proposal is adopted. In contrast, the water delivered by MPUI to Kualapuu Town is at a wholesale rate, and the point of delivery to Kualapuu is in relatively close proximity to the Well 17, and thus does not have substantial transportation-related costs or water treatment processing costs.

Potable water delivered to Wai'ola O Molokai at the West end of Molokai should not be charged at the same bulk sales (wholesale) rate applicable to deliveries of Well #17 water at the Kualapuu connection. WMA and DCA have requested separate cost of service studies for these transactions, but MPU has steadfastly refused to provide them. The rate for water deliveries at the West end should be based on the actual cost of the water treatment plant, prorated

between the utility companies on the basis of the quantities of water delivered in the Test Year or some other well documented time period. Clearly, neither utility company should subsidize the other.

WMA used the wholesale rate in these calculations as an interim value until a more precise rate could be determined.

The golf course is a subscriber to potable water, and thus needs to be charged the same usage rate as other consumers of potable water in the MPUI service area. There is no easy, equitable way to differentiate a golf course usage rate from regular (smaller) customers' consumption charges. The golf course's location in MPUI's service area and transport, storage and treatment costs have been incurred, in order to serve the golf course.

 There is no economic justification for a volume discount or any other reduction in the consumption charge for the potable water provided to the golf course.

WMA recognizes that the overall cost of water is a key factor in the golf course's viability and profitability, and will cooperate with the Owner in any reasonable, practical plan to reopen the full 18 holes, or even the front 9 holes.

One alternative is to use non-potable water for irrigation purposes, in addition to the wastewater effluent from MOSCO's Kaluakoi treatment plant. Additional non-potable water could be obtained from either

source of untreated surface water at the West end of Molokai (i.e., Well #17 water via the MIS or MPL's Mountain Water System) and would be delivered to the golf course by a separate set of pipelines. Some of the necessary infrastructure is already in place. More specifically, the non-potable pipelines used prior to 2005 to transfer backwash water from Puuokoli to the golf course. However, WMA has no knowledge of the extent/condition of these pipelines, the remaining irrigation pipelines within the Papophaku Ranchlands subdivision, or of any other pipelines on MPL's property that might be suitable for such use. Again, obtaining detailed construction drawings and other technical information for the existing elements is a prerequisite to any feasibility study.

SPONSOR:

Larry Fujino

### MPU-IR-WMA-126 Ref: WMA-306

- a. Provide calculations supporting the annual revenues on Exhibit WMA 306.
- Provide explanation for (e) shown on the line for Wholesale
   revenue from WOM for WTP.
- c. Explain the late fee increase of 200% over the present rate revenue when WMA is proposing an increase of approximately 100%.
  - Identify which customer classifications will cause the increase in the late payment fee revenue.

### **RESPONSE:**

- a. Please refer to WMA's response to MPU-IR-WMA-113, with regard to WMA not being required to perform calculations.
- b. The "E" stands for "estimate." The lack of data available to WMA prevented WMA from calculating the costs of processing water at the Puunani Treatment Facility, which serves both WOM and MPUI. If the costs were known, WMA would be proposing a TG rate identical to or similar to the costs of processing a TG of water.
- c. As hopefully was evident, WMA did not take the easy way of spreading revenue requirement "across-the-board," in a fashion that appears equitable but is, in effect, closely inequitable. Rather, WMA has attempted to align costs with rates. With regard to identifying customer classifications which may cause late payment fees, no such effort was undertaken by WMA.

### **CERTIFICATE OF SERVICE**

The undersigned certifies that the requisite number of copies of the foregoing document was or will be served on the following parties on the date indicated below, at the indicated addresses:

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DATED: Honolulu, Hawaii, January 28, 2010.

WILLIAM W. MILKS, Attorney for

West Molokai Association